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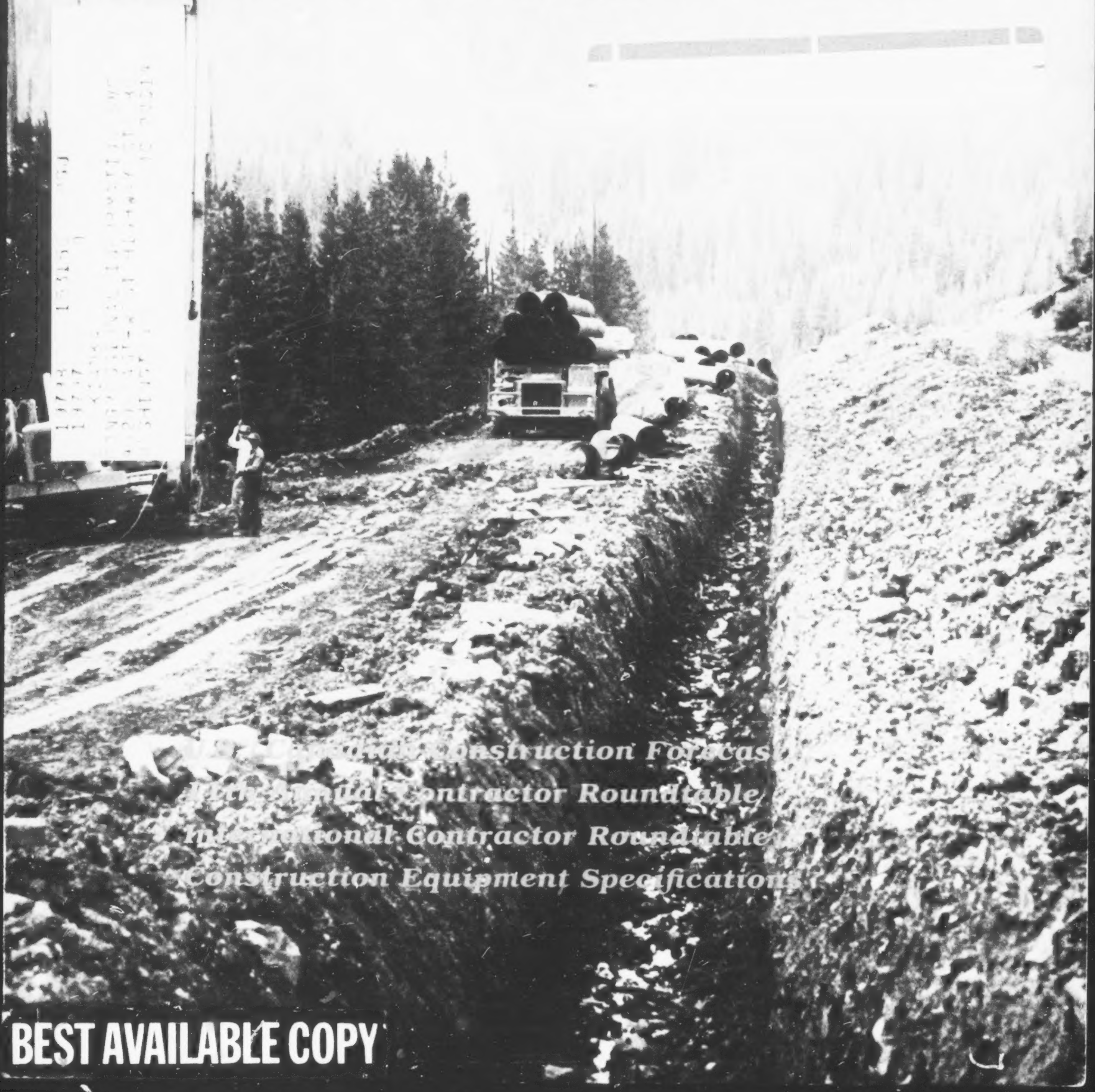

[illegible] Construction Forecast

[illegible] Annual Contractor Roundtable

International Contractor Roundtable

Construction Equipment Specifications

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PIPELINE & GAS JOURNAL

International Pipeline & Gas Utility Design, Construction & Operation

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THE COVER
"Magnum Four" universal flatbed carrier was used for first time to haul pipe for stringing on prebuild work in southeast British Columbia.

*—Photo courtesy of Alan Bailey, **Natural Gas Today**.*

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Pipeline Construction Outlook Great 20
Exclusive 11th annual P&GJ Contractor Roundtable summary: 1981 will be great year for gas pipeline construction; new outlook in Washington will improve nation's energy lot, economy; people and equipment shortages probable as Alaska gas pipeline work expands.

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School of Welding Technology in Ohio has been training skilled welding personnel for over a half-century.

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Largest diameter steel pipe mill now being operated by Berg Steel Pipe Corp.

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Reading & Bates Construction Co. unveils 1 million-lb pull horizontal drilling machine to make super-crossings under rivers.

Construction Forecast

—Photo by Larry Lee, courtesy of Pacific Interstate Transmission Co.

Western leg of the prebuild sections of the Alaskan Highway Gas Pipeline Project is underway with 341 miles of 30 and 24-in. being built by Northwest Pipeline Corp. and 160.5 miles of 42-in. by Pacific Gas Transmission. Shown here, weldor at work on NWPL's 30-in. line in Oregon.

Pipeline Construction Activity To Be Up Over 25% In 1981

by Dean Hale, *Editor*

Pipeline construction activity in the United States in 1981 is expected to show an increase of over 25% compared to 1980 as the number of pipeline projects planned, proposed, or underway reached a total of 36,567 miles at the beginning of 1981. Over 11,239 miles of cross-country pipelines are expected to be installed during 1981 as mainlines and gathering systems, according to PIPELINE & GAS JOURNAL's annual U.S. Pipeline Construction Survey.

Total for all planned, proposed, or underway projects in the U.S. plus Canada is 46,275 miles. Over 2000 miles of mainline and gathering lines are expected to be installed in Canada during 1981, much of it to be large diameter gas pipeline (see related article in this issue).

The total of 12,200 miles of pipeline construction in the U.S. and Canada provides a morale-building boost to the pipeline business and to cross-country pipeline contractors, all of whom have been wondering if predicted gains in activity were just illusory.

In the United States, the breakdown is 16,787 miles of

1981 PIPELINE OUTLOOK

Miles Planned or Underway

Type of Line	U.S.	Canada
Natural Gas	16,787	7,822
CO_2 (Carbon Dioxide)	1,168	—
Crude Oil	4,819	1,278
Products	5,500	608
Slurry	8,293	—
TOTALS	36,567	9,708
GRAND TOTAL, U.S. and CANADA		46,275

Projected 1980 Completion, Miles

Type of Line	U.S.	Canada
Natural Gas	4,124	
CO_2	578	
Crude Oil	720	2,000
Products	2,370	
Slurry	—	
Oil/Gas Gathering	3,447	
	11,239	2,000
GRAND TOTAL		13,239

gas pipelines, 1168 miles of carbon dioxide pipelines, 4819 miles of crude oil pipelines, 5500 miles of refined products pipelines, and 8293 miles of coal slurry pipelines.

Biggest stimulant for the pipeline construction business has been the prebuilding of various sections of the Alaskan Highway Gas Pipeline Project in lower Alberta and British Columbia and in the Pacific Northwest states. Canada's National Energy Board decision to permit short-term exports (3.75 trillion cu ft by 1987) was instrumental in getting the prebuild work underway. Construction is now underway on the western leg of the pipeline system, with 341 miles of 30 and 24-in. pipeline being installed by Northwest Pipeline Corp. and 160.5 miles of 42-in. in loops on its 36-in. system by Pacific Gas Transmission Corp. The latter job got underway in mid-December 1980. Although gas was to begin flowing by late 1980, it now appears that first gas deliveries won't be made until some time in 1981.

Work on the eastern leg in the U.S. — the Northern Border Pipeline's 823-mile, 42-in. line from Monchy, Sask., on the U.S.-Canadian border to Ventura, Iowa — won't begin until spring. No contract awards will be announced until mid-January, at the earliest. The Canadian section of the eastern leg, some 395 miles of 42-in., will get underway in late spring or early summer. The one-year delay in construction on all of the eastern leg was caused by a State of North Dakota challenge to the pipeline routing.

The pipeline construction outlook in the United States for 1981—miles expected to be completed during the year—is 4124 miles of gas transmission pipelines, 578 miles of carbon dioxide (CO_2) pipelines, 720 miles of crude oil pipelines, 2370 miles of refined products pipelines, and 2477 miles of oil and gas gathering lines. A total of just over 2000 miles of pipelines of all types, including gathering lines, is forecast for Canada in 1981.

Gas Pipelines

As mentioned previously, work on prebuild sections of the Alaskan Highway Gas Pipeline Project is underway, with actual construction in progress on the western legs. There will remain, however, another 480 miles of loops on Pacific Gas Transmission's 36-in. mainline, with some of it to be 42-in. and most of it to be 36-in. to provide a second 36-in. line to the Oregon-California border. Another 290 miles of 36-in. is eventually to be installed by Pacific Gas & Electric as its part of the western leg.

Just for insurance, the Rocky Mountain Gas Pipeline proposed by Pacific Gas Transmission—695 miles of 20, 30, and 36-in. from Green River, Wyo., to near Needles, Calif. —would deliver gas from the rapidly developing Overthrust Basin area of southwest Wyoming, northwest Colorado, and northeast Utah.

Moving gas from the same general region eastward to western, midwestern, and eastern markets is the proposal of the Trailblazer Pipeline System, a $500-million project to take gas from the Rock Springs area. Mountain Fuel Supply Co. would build and operate 88 miles of 30-in., in western Wyoming; Colorado Interstate would build and operate a 264-mile, 36-in. section from western Wyoming to near Cheyenne, and Trailblazer Pipeline would be built by an affiliate company of Natural Gas Pipeline Co. of American (Peoples Gas of Chicago) and Columbia Gulf Transmission Co. NGPL would operate the 445-mile, 36-in. segment.

United Gas Pipeline Co. has two projects on the board— the 635-mile, 30-in. line from the Panhandle of Texas across Oklahoma and southwest Arkansas to West Monroe, La., a $386-million project—plus a 115-mile, 30-in. line from Ft. Bend County, Tex. to San Jacinto County, Tex., to provide additional transportation capacity from south Texas to the Houston area.

Northern Natural Gas plans include a 160-mile, 12-in. or larger gas line in southwest Texas to cost $35 million.

Florida Gas Transmission Co. will be building some 309 miles of 30-in. loops on its gas system if final FERC approval is received early in 1981. An administrative law judge has ruled that FGT can abandon its original 890-mile, 24-in. gas system (for conversion to products pipeline service) once the new loops are built and are operable.

Ozark Gas Pipeline expects a decision in early 1981 on its plan to build 445 miles of 4 to 20-in. gas pipelines in Oklahoma and Arkansas to provide a new outlet for Anadarko Basin gas.

Transcontinental Gas Pipeline Corp. and Algonquin Gas Transmission Corp. see light at the end of the tunnel in their plans to build a 350-mile gas pipeline from near Calais, Maine, to Burnville, R.I., to bolster gas supplies in the Northeastern U.S. Gas would come from the Trans-Quebec & Maritimes Pipelines, Ltd. projects; TQ&M plans to bring western Canadian gas to the Maritime Provinces and would export 250 million cu ft per day to U.S. markets.

Two other Northeastern U.S. gas pipeline projects remain on the books in various states of activity—the New England States Pipeline (350 miles of 30-in.) and the Tenneco Atlantic Pipeline, a 450-mile, 26-in. proposal between St. Johns, N.B., and Nassau, N.Y.

Offshore gas pipeline projects abound. Columbia Gulf Transmission and Natural Gas Pipeline Co. of America plan 127.7 miles of 10, 12, and 20-in. in the Eugene Island and West Cameron areas offshore Louisiana; Corpus Christi Oil and Gas plans a 250-mile, 24-in. line offshore Texas; Florida Gas Transmission and Tennessee Gas Pipeline plan 40 miles of 22-in. offshore Texas; High Island Offshore System plans 66 miles of 36-in.; Seagull Pipeline Co. plans 275 miles of 24-in. offshore Texas; Southern Natural Gas has projects totaling over 300 miles offshore Louisiana; Tennessee Gas Pipeline and Texas Eastern plan 174 miles of 16 thru 36-in. line offshore and onshore Texas and Louisiana; and Transcontinental Gas Pipeline Corp. has over 125 miles of various size offshore pipelines planned.

Two other projects of note include Western LNG Terminal's 286 miles of 42 and 48-in. from Point Conception to the Los Angeles area (whose construction depends on the final outcome of the LNG importation scheme to bring Indonesian gas to the U.S. West Coast), and Great Lakes Gas Transmission's continuing plan to build 365 miles of 30-in. to deliver gas from the Great Plains Coal Gasification Plant site in North Dakota to Thief River Falls, Minn. The coal gasification plant is currently stalled in the courts.

Carbon Dioxide Pipelines

Three CO_2 pipeline projects are underway in the U.S.— 30 miles of 10-in. between LaPorte and Texas City, Tex., for Air Products & Chemicals; 106 miles of 6-in. from Orla, Tex., to Fort Stockton, Tex., for Conoco, Inc.; and 42 miles of 8-in. in Mississippi for Pennzoil Production Co. The latter two reportedly are to transport CO_2 for use in enhanced recovery projects.

Atlantic Richfield is moving ahead with its 400-mile, 20-in. line from near Walsenburg, Colo. to Seminole, Tex., and Shell Oil Co. is proceeding with development of a carbon dioxide field and 500-mile, 20-in. pipeline to transport the gas from near Cortez, Colo., to the Wasson Field in West Texas. Mobil Oil Co. reportedly will join Shell in the Cortez Pipeline Co. project. The entire project is expected to be in operation by 1983. Shell is also planning a 90-mile, 20-in. CO_2 pipeline in Mississippi to supply an enhanced recovery project.

Crude Oil Pipelines

Northern Tier Pipeline Co., which has acquired nearly all of the major permits and approvals for its 1557-mile, 40 and 42-in. oil pipeline, hopes to resolve the controversy revolving around its terminal near Port Angeles and being perpetuated by obstructionists offering no alternatives.

Obstructionists posing as environmentalists also effectively deferred the Northern Pipeline Co. of Delaware project—a 480-mile, 24-in. line to transport crude oil from Wood River, Ill. to St. Paul, Minn. That $130-million proposal by Koch Industries has now passed into oblivion. In its place came the Wood River Pipeline project—446 miles of 20 and 24-in. at a cost of $120 million. Final delivery route for the oil is longer and will cost more as delivered, but it did bypass the never-ending struggle. Project involves a new line from Wood River to Bethany, Mo., by Koch, a 193-mile, 24-in. loop by Williams Pipeline from Bethany to Mason City, Iowa, and final delivery through an existing 130-mile, 18-in. line from Mason City to the Minneapolis-St. Paul area.

Only other major crude oil pipeline undertakings announced as of 1981's beginning include 115 miles of 10-in. from Medford, Okla., to Conway, Kans., by Western Crude Oil, and Pacific Coast Pipeline's plans to pick up on the now defunct California-to-Texas Pactex project abandoned by Sohio.

Products Pipelines

Mapco, Inc. plans to continue its 1197-mile Rocky Mountain LPG system by extending it from Seminole, Tex. to the Houston/Mt. Belvieu area with 630 miles of 14 and 16-in.

Koch Hydrocarbons plans a 580-mile system from Medford, Okla., to the Houston area, which will require 380 miles of 8 and 10-in. connecting to an existing 200-mile line acquired by Koch.

Still lurking in the wings is the 890-mile, 24-in. conversion project of Transgulf Pipeline, an affiliate of Florida Gas Transmission Co. An FERC administrative law judge has approved sale of the existing 24-in. gas line from near Baton Rouge to Ft. Lauderdale, Fla., once FGT builds the necessary 309 miles of 30-in. loops on its gas system. The FERC judge said that, although the move would do harm to barges and ship traffic now transporting petroleum products to Florida, it would be beneficial to consumers.

Slurry Pipelines

There are now nine projects involving 8293 miles of slurry pipeline—all proposed for the movement of coal from mine to electric generating plants. Most likely project to come into existence is the Energy Transportation Systems, Inc. line, which is inching closer and closer to a construction beginning.

A new regime in Washington is expected to press harder for the right of *eminent domain* for slurry pipelines, and the firms involve remain confident they will eventually be given permission to build and operate their pipelines. **P&GJ**

Planned And Proposed Pipeline Projects

U.S. — Natural Gas Pipelines

COMPANY	MILES	SIZES (IN.)	FROM	TO	COST ($MILLIONS)	STATUS	CONTRACTOR OR ENGINEERING CO.
Alabama-Tennessee Natural Gas Co.	17.7	8	Lamar County, Miss.	Forrest County, Miss.	1.8	Planned	
Ammonia Enterprises Pipe Line Inc.	52	10	offshore-onshore La.			Planned	
Baltimore Gas & Electric Co.	40	3/8-20	Central Maryland		3.3	Underway	Company crews
Bear Creek Storage Co.	25.5	6-18	Bienville Parish, La.		60.7	Underway	Hallico and Trend Construction Co.
Brooklyn Union Gas Co.	23.4	2-24	Brooklyn, Queens, Staten Island, N.Y.		13.6	Planned	Company Crews
Cities Service Gas	76	4-12	Wyoming		5.8	Underway	Sterling Construction Co.
Citizens Gas & Coke Utility	79	1 1/4-16	Marion County, Ind.		3.7	Planned	Company crews
Colorado Interstate Gas Co.	225	2-10	Tex., Okla., Kans., Wyo., Colo., Utah		16.6	Underway	Sterling Construction Co., Holloman Construction
Columbia Gas Transmission Co.	23	12, 16	Flat Top, WV	Forest Hill, WV		Underway	Pace Pipe
	72	16, 20	Varney, WV	Ona, WV		Underway	Carl E. Smith
	26	8	Clay, Owsley, Lee, Estill counties, Ky			Planned	
	347	2-26	Ohio, NY, Pa., Md., WV, Va., Ky.			Planned	Company crews
	56	10, 12	Chautaqua County, NY; Washington County, Ohio		10.6	Underway	L. A. Pipeline Co.
	38.7	6-10	Eric and Crawford counties, Pa.		6.3	Underway	Utility Constructors
Columbia Gulf Transmission Co.	12.9	10-16	Ship Shoal, offshore La.		9.5	Planned	
	21	6-10	Offshore La.		9	Planned	
	11	6	Eugene Island block 314C			Planned	
	4.9	12, 16	Offshore La.		9.9	Planned	
Columbia Gulf Transmission Co. and Natural Gas Pipeline Co. of America	127.7	10, 12, 20	Eugene Island & W. Cameron areas, offshore La.			Planned	
Commonwealth Gas Co.	13	2, 6	Central Mass.		0.6	Planned	
Consolidated Gas Supply Corp.	7.5	20	High Island offshore area, Tex.		8.1	Planned	
	19	24	Ritchie County, Va.	Doddridge County, Va.		Underway	Carl E. Smith
	9	8	Buck Run, Wetzel, Tyler counties, Va.			Underway	
	63	30	Canten, Ohio	Ohio River		Planned	
Consumers Power Co.	22	4, 6	Lower Michigan		3	Planned	
Corpus Christi Oil & Gas	250	24	Offshore Texas			Planned	
El Paso Natural Gas Co.	463	30-36	Port O'Connor, Tex.	Ft. Stockton, Tex.		Planned	
	30	4, 10, 16, 20	San Juan Co., N.M.			Planned	
	119.8	6 5/8, 20, 24	Eddy County, N.M.			Planned	
Florida Gas Transmission Co.	33.3	4, 8, 10	Offshore Texas		9.5	Planned	
	92.8	22, 26	Offshore Texas	Louisiana	34.6	Planned	
	375.8	4 1/2, 20, 26, 30	Zachary, La.	Ft. Lauderdale, Fla. (loops)		Planned	
	41.3	2, 24	Offshore Tex.	Refugio County, Tex.		Planned	
	309	30	loops on existing system			Planned	
Florida Gas Transmission Co. and Tennessee Gas Pipeline Co.	40	22	Offshore Tex.	Jefferson County, Tex.		Planned	
Great Lakes Gas Transmission Co.	30.1	36	Kittson, Clearwater, Beltrami counties, Minn.		18.7	Planned	
	125	36	Minn., Wisc., Mich.			Planned	
	365	20	Mercer Co., N.D.	Thief River Falls, Minn. (SNG)		Planned	
Gulf Energy & Development Co.	50	10-14	South Texas			Planned	
Gulf States Utilities Co.	110	1/2-8	East Baton Rouge Parish, La.		1.5	Planned	
High Island Offshore System	66	36	Offshore Texas		101	Planned	
Houston Pipe Line Co.	10	4, 12	Harris County, Tsx.		12	Planned	
	20	20	Klebert, Nueces counties, Tex.		10	Planned	
	5	24	Harris County, Tex.		3	Planned	
	92	20	Corpus Christi			Underway	H.K. McDermott Inc.
Kansas-Nebraska Natural Gas Co.	22.3	16	Lexington, Neb.	Riverdale, Neb.	2.5	Planned	
	18.1	16	Cairo, Neb.	Grand Island, Neb.	2.1	Planned	
	190	4, 6	Colo., Mont., Wyo.		8	Planned	
Lear Petroleum	85	20	Caddo, Grady, Washita counties, Okla.			Underway	Cap-Con
Louisiana Intrastate Gas Corp.	45	24	Irene, La.	Placquemine, La.	22	Underway	Ashley Enterprises
Matador Pipelines Corp.	60	16	Billings, Golden Valley, McKenzie counties, N.D.			Underway	Santa Fe Pipeline Construction Co.

COMPANY	MILES	SIZES (IN.)	FROM	TO	COST ($MILLIONS)	STATUS	CONTRACTOR OR ENGINEERING CO.
Michigan-Wisconsin Pipe Line Co.	63.2	12, 24, 30	Offshore La.	Onshore La.	73.9	Planned	
	3.5	10	Offshore Texas		4.9	Planned	
	49	12, 20	Tex., Okla., Kans.		16.8	Planned	
	81.4	36, 42	La., Ind., Ky., Miss.		62.2	Planned	
	12.1	42	Ind., Mich.		15.9	Planned	
	66	36	Offshore Tex.		101	Planned	
	15.3	30	Lowrey, La.			Planned	
Montana Fuel Supply Co.	35	10	Converse County, Wyo.	Douglas, Wyo.		Planned	
Mountain Fuel Supply Co.	4	20	Sweetwater County, Utah		1.2	Planned	
	392	2-10	Utah, Wyoming		6	Underway	Company crews
National Fuel Gas Supply Corp. & Natural Gas Storage Corp.	22	4-12, 16-36	Ellisburg, Pa.			Planned	
Natural Gas Pipeline Co. of America	8.4	6	Galveston	Offshore Tex.		Underway	Ingram Marine Construction
	26.9	16	High Island offshore Tex.			Underway	Brown & Root
	2.4	16	South Pass offshore Tex.			Underway	
	3.5	12	West Delta offshore La.			Underway	
	5	10	West Cameron offshore La.			Underway	
	2.7	8	West Cameron offshore Tex.			Underway	
	14.2	8	High Island offshore Tex.			Planned	
	48	30	Beckham County, Okla.	Hutchinson County, Tex.	18.9	Underway	H.B. Zachry Co.
	222	4, 10	Colo., Neb.		36	Planned	
	16	6, 12	Offshore Tex.		13.5	Proposed	
New England States Pipe Line	350	30	Northeast U.S.		420	Planned	
Northern Border Pipeline Co.	823	42	Montana	Illinois	1500	Underway	William Bros. Engineering
Northern Natural Gas Co.	50	12	Eddy Co., N.M.	Hobbs, N.M.		Planned	
	160.6	12, 16	Batesville, Tex.	El Dorado, Tex.	59.3	Planned	
	40	4-12	Batesville, Tex.	LaPryor, Tex.		Planned	
	13	6, 10	Offshore Tex.			Planned	
	4	6	Offshore La.			Underway	
	42.5	24	Offshore Refugio County, Tex.			Planned	
	15.2	12, 16	Offshore La.		5.79	Underway	Brown & Root
	45	12, 24	Offshore Tex.			Underway	
Northwest Alaska Pipeline Corp	739	48	Prudhoe Bay	Alaska-Yukon border	3900	Planned	
Northwest Pipeline Corp.	341	24, 30	Oregon, Idaho		144	Underway	Banister, Great Plains, MK-River, Hood, Mid-Mountain
	80	6-12	Lincoln, Unita, Sweetwater cos., Colo.			Planned	
	200	4-12	Moxa Arch area, Wyo.		20.3	Underway	
Nueces Co.	24	4, 12	Kit Carson County, Colo.		1.3	Planned	
Oasis Pipe Line Co.	20	10, 12	Loving County, Tex.		5	Planned	
Oklahoma Natural Gas Co.	98	to 30	Oklahoma			Planned	
	30	12	Beaver County, Okla.	Ellis County, Okla.	3.6	Underway	K.M. Engineering
Ozark Gas Pipeline Corp.	445	4-10, 20	Pittsburg, Okla.	White County, Ark.	104	Planned	
Pacific Gas & Electric Co.	290	36	Malin, Ore.	Brentwood, Calif.	236	Planned	
	40	30	Searchlight, Nev.	Southeast Calif.		Planned	
	162	16-36	California		9.4	Planned	Company crews
	8	20, 26, 30	California		4.55	Underway	Company crews
	36	16-26	California		22.73	Underway	Company crews
	28	30	California		19	Planned	
	103	34	California		91	Planned	
Pacific Gas Transmission Co.	160.5	42	Idaho, Ore., Wash.		116	Underway	M-K River
	432	36	Idaho, Ore., Wash. (loops)		301	Planned	
(Rocky Mountain Pipeline)	695	20, 30, 36	Green River Basin, Wyo.	Needles, Calif.	341	Planned	
Panhandle Eastern Pipeline Co.	110	4-12	Wyoming		24	Planned	
	60	4-8	Greely, Hamilton, Kearney counties, Kans.			Planned	
	60	4, 8, 16	Weld and Boulder counties, Colo.		6.9	Underway	
	56.6	6, 16	Kans., Okla., Tex.		25.7	Planned	
Pioneer Natural Gas	30	2-8	Texas Panhandle		1.5	Planned	
Rocky Mountain Natural Gas Co.	41	8 5/8	DeBeque, Colo.	Piceance Creek, Colo.		Planned	
Seagull Pipeline Co. (Houston Oil & Mineral Co.)	275	24	Cameron County, Tex.	Bolivar Penninsula		Planned	
Southern California Gas Co.	12	36	Aliso Canyon	Los Angeles		Underway	Hood
Southern California LNG Terminal Co.	63	32	Ventura County, Calif.			Planned	
Southern Natural Gas	40	18	Offshore La.		9.6	Planned	
	31.2	20	Thomaston, Ga.	Griffing, Ga.		Planned	
	20.7	18	S. Atlanta, Ga.	Austell, Ga.		Planned	
	44.7	12 3/4	Dalton, Ga.	Rome, Ga.		Planned	
	7.8	8	Offshore La.		1.56	Planned	
	22.46	16	Offshore La.		23	Planned	
	96.6	12-20	Clayton, Gordon, Douglas counties, Ga.		30.2	Planned	
	231	16	Offshore La.		23.8	Planned	
Southwest Gas Corp.	76	12, 20	Northern Nevada		26.1	Underway	
Southwestern Gas Pipeline	27	12 3/4	Millsap, Tex.	Morgan Mill, Tex.		Underway	Conner Construction
Tenneco Atlantic Pipeline	450	26	St. Johns, N.B.	Nassau, N.Y.		Planned	
Tennessee Gas Pipeline Co.	26.3	16, 20	Offshore La.		28.4	Planned	
Tennessee Gas Pipeline Co. and Texas Eastern	174.3	16, 24, 30, 36	Offshore/onshore Tex. and La.		274.1	Planned	
Tennessee Gas Pipeline Co. and Columbia Gulf Transmission Co.	26	26, 36	South Pass area, offshore La.		46.8	Planned	
Texas Eastern Corp.	113.4	30	Gillis, La.	New Roads, La.	125.7	Planned	
	58.5	36	St. Francisville, La.	Kosciusko, Miss.		Planned	
Texas Gas Transmission Corp.	6.58	10	High Island, offshore Tex.		6.1	Underway	
	20.45	4-12	St. Mary, Lincoln, Bienville, Assumption parishes, La.		3.2	Underway	
	10	10	Lincoln Parish, La.		1.9	Planned	
	4	12	High Island, offshore Tex.		6.3	Planned	
	32	20	Cameron Parish, La.		14	Planned	
Texas Sea Rim Pipeline Inc.	14	14	Sabine Pass area, offshore Tex.			Planned	
Trailblazer Pipeline (Natural Gas Pipeline Co. of America, Colorado Interstate Gas Co., Columbia Gulf Transmission Co., Mountain Fuel Supply Co.)	797	30, 36	Rock Springs, Wyo.	Beatrice, Neb.	430	Planned	
Trans-Anadarko Pipeline System	635	30 or 36	Texas Panhandle	Northern Louisiana		Proposed	
Transcontinental Gas Pipe Line Corp.	61	24	Texas		37.8	Planned	
	20.3	36	Louisiana		24	Planned	
	7.5	12	Louisiana		1.9	Planned	
	19	4, 8, 12	Louisiana		5.7	Planned	
	4	10	Offshore La.		4.4	Planned	
	7.5	6, 8	Offshore La.		4.7	Planned	
	28.1	10, 24	Offshore Tex.		24	Planned	
	3	16	Offshore Tex.		2	Planned	
	8.5	20	Offshore Tex.		2	Planned	
	12.9	20	Offshore Tex.		7.8	Planned	
(ownership interest)	31.2	20	Offshore Tex.		9.7	Planned	
(ownership interest)	15.3	10, 12	Offshore La., Tex.		4.4	Planned	
(ownership interest)	18.3	2, 24	Louisiana		2.2	Planned	
	88.56	20, 24	Offshore, onshore Tex.		78.4	Planned	
Transcontinental Gas Pipeline Corp. and Algonquin Gas Transmission Corp.	350	N/A	Calais, Maine	Burrillville, R.I.	420	Planned	
Transok Pipe Line Co.	85	2-8	Oklahoma		3	Underway	K-M Engineering, Great Southern, G&J Construction
	18	10-20	Oklahoma		2	Underway	K-M Engineering, Great Southern, G&J Construction
Trunkline Gas	79	16, 20, 30	Terrebone Parish, La.		64	Planned	
United Gas Pipe Line Co.	22	30	Vermilion Parish, La.			Planned	
	5	4	Louisiana			Planned	
	5	6	High Island, offshore La.	Cameron Parish, La.		Planned	
United Gas Pipe Line Co.	9	8	Rusk County, Tex.			Planned	A&A
	115	30	Ft. Bend County, Tex.	San Jacinto, County, Tex.	81	Planned	

COMPANY	MILES	SIZES (IN.)	FROM	TO	COST ($MILLIONS)	STATUS	CONTRACTOR OR ENGINEERING CO.
Valero Transmission Co.	212	16, 20	South Texas		44.3	Planned	
	50	36	North Texas		25	Planned	
	25.3	20, 24	Southeast Texas		44.3	Planned	
	20	12	East Texas		5	Planned	
Western LNG Terminal	286	42, 48	Pt. Conception, Calif.	Los Angeles area		Planned	

U.S. — Crude Oil Pipelines

COMPANY	MILES	SIZES (IN.)	FROM	TO	COST ($MILLIONS)	STATUS	CONTRACTOR OR ENGINEERING CO.
ARCO Oil & Gas	26	16	Kuparuk Field, North Slope	Alyeska Pump Station No. 1		Underway	M-K River
Ashland Pipe Line Co.	53	various	La., Ill. (gathering lines)			Planned	
Bigheart Pipeline Co.	60	2-6	Oklahoma		2.5	Planned	
DEEPORT	31	36	Harbor Is. Bay, Tex.	Corpus Christi, Tex.	500	Planned	
Department of Energy	14	16	Eastern Ky. strategic storage			Proposed	
	13	20	Southern Ohio strategic storage			Proposed	
New England Energy Co.	35	24	Portland, Maine	Sanford, Maine		Planned	
Northern Tier Pipeline	1550	40, 42	Port Angeles, Wash.	Clearbrook, Minn.	1400	Planned	Butler (E); Williams Bros. (E)
Northville Industries	211	30, 36	Galveston-Freeport	Texas City-Nederland		Planned	Brown & Root (E)
Pacific Coast Pipeline	1107		California	Texas		Planned	
Shell Oil Co.	17.3	16	San Pedro, Calif.	Long Beach, Calif.		Underway	
Shell Pipe Line Co.	11	6	Louisiana			Planned	
Texaco-Cities Service Pipeline Corp.	36	24	Southeast La.		50	Planned	
United Gas Pipe Line Co.	21	16	Harrison and Panola counties, Tex.			Planned	
	43	30	Natchitoches, Winn, LaSalle parishes, La.		27.8	Planned	
	5.3	10	Offshore Tex.		3.73	Planned	
United States Navy	135	30	Naval Petroleum Reserves, Redland, Calif.			Planned	
Upland Resources Inc.	24	4, 8	Mineral County, Va.			Underway	Joyce Western
Wallace & Wallace Chemical & Oil Co.	214	22-30	Mobile, Ala.	Tuskogee, Ala.		Planned	Ford, Bacon & Davis
Western Crude Oil	115	10	Medford, Okla.	Conway, Kans.		Planned	
Wood River Pipeline Co.	446	20, 24	Minn., Iowa, Ill.		135	Underway	Great Plains Construction, Gregory & Cook, Wilbros Energy Services.
Standard Oil Co. (Ohio)	312	10, 12	Salem, Ill.	Lima, Ohio	7	Underway	International Engineering

U.S. — Products Pipelines

COMPANY	MILES	SIZES (IN.)	FROM	TO	COST ($MILLIONS)	STATUS	CONTRACTOR OR ENGINEERING CO.
Ashland Pipeline Co.	74	8	East Sparta, Ohio	Heath, Ohio		Planned	
	5	6	Western Ky.			Planned	
Barbour Energy Co.	390	20	Brownsville, Tex.	Houston		Planned	
Big Three Industries	67	12	Victoria, Tex.	Bay City, Tex.		Planned	
Buckeye Pipe Line Co.	22	10	Lawrenceville, Ohio	Robinson, Ill.	3	Underway	
	14	12	Ohio			Planned	
Coastal States Crude Gathering Co.	12.8	6	East Whites Point, Tex.	Clarkwood, Tex. (LPG)		Planned	
Enterprise Products Co.	55	6	Jay, Fla.	Alabama-Miss. border		Planned	
Exxon Pipeline	18	8	Southern Louisiana			Planned	
	14.4	4	Baton Rouge area			Planned	
	10	8	Houston area			Planned	
Farmland Industries	70	12, 16	Louisiana			Planned	
Getty Pipeline	25	16	Delaware City, Dela.	Marcus Hook, Pa.	10	Planned	
Gulf Refining Co.	36	10, 14	West Texas			Planned	
Koch Hydrocarbons	380	8, 10	Medford, Okla.	Houston		Planned	
MAPCO Inc.	1197	4-12	Seminole, Tex.	Rock Springs, Wyo.	110	Underway	Majestic Wiley, Curran Houston, Santa Fe Southeast
Seminole Pipeline Co. (MAPCO)	630	14, 16	Seminole, Tex.	Brenham, Tex.	130	Underway	
Shell Pipe Line Corp.	21.4	24	Norco, La.	Garyville, La.		Planned	
	11	6	Sorrento, La.	Convent, La.		Planned	
Southern Pacific Pipeline Inc.	36	24	Norwalk, Calif.	Colton, Calif.		Planned	
Southern Union Refining Co.	63	6	Lovington, N.M.	Artesia, N.M.		Underway	Ferguson Construction
Southern Union Refining Co. and Navajo Refining Co.	78	8	Artesia, N.M.	Orla, Tex.		Underway	McVean & Barlow
Texas Eastern Products Pipeline	9.8	8	Mt. Belvieu, Tex.	Baytown, Tex.		Planned	
Transgulf Pipeline (Gas line conversion)	890	24	Baton Rouge, La.	Ft. Lauderdale, Fla.	140	Planned	

U.S. — Carbon Dioxide (CO^2) Pipelines

COMPANY	MILES	SIZES (IN.)	FROM	TO	COST ($MILLIONS)	STATUS	CONTRACTOR OR ENGINEERING CO.
Air Products & Chemicals	30	10	La Porte, Tex.	Texas City, Tex.		Underway	Gregory & Cook
Atlantic Richfield	400	20	Walsenburg, Colo.	Seminole, Tex.		Planned	
Cortez Pipeline Co. (Shell Pipeline Co.)	500	20	Cortez, Colo.	West Texas (Wasson Field)		Planned	
Conoco Inc.	106	6	Fort Stockton, Tex.	Orla, Tex.		Underway	McVean & Barlow
Pennzoil Production Co.	42	8	Rankin, Madison, Yazoo counties, Miss.			Underway	Cap-Con International Inc.
Shell Oil Co.	90	20	Mississippi			Planned	

U.S. — Slurry Pipelines

COMPANY	MILES	SIZES (IN.)	FROM	TO	COST ($MILLIONS)	STATUS	CONTRACTOR OR ENGINEERING CO.
Allen-Warner Valley Energy Systems (Nevada Power Co.)	183	20, 24	Alton, Utah	Las Vegas, Nev.		Planned	
Continental Resources Inc. (formerly Florida Gas Transmission)	1500	24-48	Kentucky	Florida	1000-1500	Planned	Fluor
Energy Transportation Systems Inc.	1400	38	Wyoming	Baton Rouge, La.		Planned	Bechtel (E)
Pacific Bulk Transportation Systems (Boeing Engineering & Construction Co.)	650		Emory, Carbon counties, Utah	Port Hueneme, Calif.		Planned	Boeing (E)
San Marco Pipeline Co. (Houston Natural Gas, Rio Grande Industries)	900	20, 24	S.E. Colorado	Texas Gulf Coast	800	Planned	
Snake River System (N.W. Energy, Gulf Interstate)	1100	20, 24	N.E. Wyoming	Idaho, Oregon		Planned	
Tesoro Petroleum Corp.	1000	30	Kentucky	Southeastern U.S.		Planned	
Virgina Electric Power Co.	300	[illegible]-36	Proud, W.V.	Portsmouth, Va.		Planned	
Wytex System (Texas Eastern, Brown & Root)	1260	36, 40	Powder River basin, Wyo.	Houston area		Planned	Brown & Root (E)

Construction Outlook

Interprovincial Pipe Line Ltd.'s 28-mile, 34-in. loop project southeast of Edmonton was plagued by bad weather and took almost three months to complete. In a drier moment, PeBen Pipelines (1979) Ltd. welders finish up a short section of pipe.

Gas Line Prebuilding Sparks Canadian Pipeline Construction

by **L. O. Rowland,** *Canadian Editor*

Canadian pipelining in the 1980's has taken off with a rush that promises to keep the big-inch contractors busy for several years.

Sparked by the start of prebuilding on the Alaska highway gas pipeline in southern Alberta and southeastern British Columbia in the fall of 1980, the 1981 outlook is for a big year that may come close to the volume experienced in the 1960's. It is mostly gas-related, but the sales contracts and export permits are firm enough to indicate there will be a sustained good level of construction until the Alaska gas line is completed in 1985.

First off for the winter season, early in January 1981, is the muskeg portion of the 100 miles of 42-in. looping by Nova, an Alberta Corporation, (formerly Alberta Gas Trunk Line), on its Edson main gas transmission line. The second and third loops, amounting to about 60 miles, are due to be completed before spring breakup.

Two other major Nova projects are also slated for winter construction. The big-inch job is the Elmworth main line to link the Deep Basin gas processing plants by an express route to Edson, the northern end of the Edson main line, where the gas will be delivered into the new 42-in. loop. The Elmworth line consists of 166 miles of 24, 30, and (mostly) 36-in. pipe and includes a 42-in. crossing of the Wapiti River near the start, making provision for future looping without a second crossing. Completion is scheduled for early spring.

Nova is also scheduling the Kirby lateral in northeastern Alberta, 120.5 miles of mostly 16-in. pipe, to provide an outlet for significant volumes of gas covered by sales contracts from Pan-Alberta Gas Ltd. (a Nova subsidiary) to the American Midwest and Rocky Mountain markets. Situated in very fluid muskeg terrain, this prime winter job is also scheduled for spring completion.

Another major small-inch project under way for winter construction is the Peace Pipe Line Ltd. crude oil and gas liquids pipeline, which will carry ethane, propane, butanes and condensate as well as light crude oil, out of the Deep Basin region near Grande Prairie to join its existing system at Simonette. This job, consisting of 113 miles of 12-in., is due for completion in mid March. Henuset Rentals Ltd. is the contractor.

The 1981 summer program will be dominated by the eastern prebuild of the Foothills system. Plans are to call tenders in the spring for kickoff as soon as the frost is out of the ground. Foothills intends to have four spreads at work for most of the summer. Foothills Pipe Lines (Alta.) Ltd. will lay 235 miles of 42-in. main line across Alberta from Caroline to Empress on the Saskatchewan border, using three spreads. Foothills Pipe Lines (Sask.) Ltd. will put down 160 miles of 42-in. from Empress to Monchy on the Montana border, which will be the takeoff point for the Northern Border pipeline, for which tenders were called in November.

TransCanada Looping

Still in doubt for 1981 is the looping of the TransCanada PipeLines Ltd. main line, which will be required eventually if American approval of two export projects is granted and if the extension of the system to eastern Quebec and the maritime provinces occurs. The latter is supposed to be a priority project, but Canada federal policy is obscure and there is no indication of a start in 1981.

There is an outside possibility that, if FERC approvals come soon enough, TCPL may be in a position to lay at least part of its 295 miles of 42 and 48-in. looping that has already been approved by the National Energy Board. This work would be spread all across the western division in Saskatchewan and Manitoba, and in the northern Ontario segment of the system.

There is, also, more than an even chance that the first

CANADA — Natural Gas Pipelines

COMPANY	MILES	SIZES (IN.)	FROM	TO	COST ($MILLIONS)	STATUS	CONTRACTOR OR ENGINEERING CO.
Alberta Energy Co. Ltd.	290	2, 10	Southeastern Alberta			Planned	L&M, South Eastern Pipeline Construction, Spade Construction
Dome Petroleum	67	3, 10	Primrose-Kirby area			Planned	
Foothills Pipe Lines (Alberta) Ltd.	395	56	British Columbia	Caroline, Alta.		Planned	
	235	42	Caroline, Alta.	Empress, Alta.		Planned	
	99	36	Caroline, Alta.	Crowsnest, Alta.		Planned	
Foothills Pipe Lines Ltd. (Dempster Highway Lateral)	740	34	Whitehorse	Mackenzie Delta area		Planned	
Foothills Pipe Lines (North B.C.) Ltd.	444	56	Northern British Columbia			Planned	
Foothills Pipe Lines (Saskatchewan) Ltd.	160	42	Empress, Sask.	Monchy, Sask.		Planned	
Foothills Pipe Lines (South Yukon) Ltd.	232	48	Southern Yukon			Planned	
	276	56	Southern Yukon			Planned	
Foothills Pipe Lines (South B.C.) Ltd.	50	36	Southeastern British Columbia			Planned	
Gaz Metropolitan Inc.	24	2, 8	Montreal area		5	Planned	
Greater Winnipeg Gas Co.	39	2, 8	Winnipeg area		2.1	Planned	
	62.3	5 8-4	Winnipeg area		1.9	Planned	
Gulf Canada Resources Ltd.	113	2-16	Hanlan, Alta.			Planned	
	42.5	3-6	Alberta		8	Planned	
Hudson's Bay Oil & Gas Co.	35	4, 6	Alberta			Planned	
Nova (formerly Alberta Gas Trunk Line)	166	24-42	Elmworth gas field	Edson		Planned	
	120.5	4, 16	Kirby field	Nova main line		Planned	
	100	42	Edson main line loops			Planned	
	42	10	Irish field, Alta.			Underway	
	40	42	Alberta			Underway	
Polar Gas Project	2338	36, 42	Melville Island	Longlac, Ont.	7100	Planned	
Shell Canada Resources Ltd.	20	3, 6	Northwest Alta.			Planned	
TransCanada Pipelines Ltd.	295	42, 48	Sask., Ont., Manitoba loops			Planned	
	100	30	Montreal	Quebec City		Planned	
Union Gas, Ltd.	47	12-42	Southwest Ontario			Planned	
	36	16, 36	Southwest Ontario			Planned	
	11.2	42	Southwest Ontario			Planned	
	10.9	42	Southwest Ontario			Planned	
	10	8, 42	Southwest Ontario			Planned	
Westcoast Transmission	470	2-16	Williams Lake	Vancouver Island	260	Planned	
	83	12-24	British Columbia			Planned	
	41	36	British Columbia			Planned	
	30	6, 8, 26	British Columbia			Planned	

CANADA — Crude Oil Pipelines

COMPANY	MILES	SIZES (IN.)	FROM	TO	COST ($MILLIONS)	STATUS	CONTRACTOR OR ENGINEERING CO.
Esso Resources Canada Ltd. (Interprovincial Pipe Line Ltd.)	560	12	Norman Wells, NWT	Zama Lake, Alta.	360	Planned	
Husky Oil Operations Ltd.	89	6, 12	Cold Lake field	Lloydminster		Planned	
Murphy Oil	38	3 1 2, 8 5 8	Unity, Sask.	Bodo, Alta.		Planned	
	20	4, 10	Blackfoot, Alta.	Hazeldine, Alta.		Planned	
Trans-Mountain Oil Pipelines, Ltd.	571	30, 36	Edmonton	U.S. border		Proposed	

CANADA — Products Pipelines

COMPANY	MILES	SIZES (IN.)	FROM	TO	COST ($MILLIONS)	STATUS	CONTRACTOR OR ENGINEERING CO.
Alberta Energy Co. Ltd.	145	6	Edmonton	Cold Lake field	68	Planned	
	145	12	Cold Lake Field	Edmonton		Planned	
Alberta Products Pipe Line Ltd.	200	10	Edmonton	Calgary		Planned	Associated-Pullman Kellogg Ltd. (E)
Peace Pipe Line Ltd.	113	12	Grande Prarie	Simonette terminal	32	Underway	Henuset Rentals Ltd.
Trans-Northern Pipe Line Co.	4.5	13	Ottawa		1.4	Planned	

stage of extension of the TCPL main line in Quebec, from Montreal to Quebec City, will be built in 1981. This would take about 100 miles of 30-in.

Gas Lines

Another small-inch main line project practically assured for 1981 is the looping of the Alberta Products Pipe Lines Ltd.'s products line between Edmonton and Calgary. Tenders were called in November for the 193 miles of 10-in., which is required to supplement the overtaxed original products line installed 10 years ago. This will be a normal summer construction job, with completion scheduled for late summer with one spread.

A few small-inch gas transmission laterals are sure to be built in 1981, but the number and timing depends on the speed with which gas deliveries through the prebuild sections of the Alaska pipeline build up. Nova has a continuous program, but it is subject to continuous change with conditions. Few producers want to build their own laterals, and the current and prospective slump in the American market, with volume through the prebuild likely to be about half the long term contracted flow, suggests a good deal of lateral construction will be deferred to 1982, when the market position should be clarified.

In any case, much of the delivery facilities are already in place to handle the initial volume through the prebuild. A rough estimate indicates that Nova may build upwards of 300 miles of laterals in addition to its big Kirby project.

LPG Lines

Gas producers have several plans for LPG laterals and some of these will probably materialize in 1981. Amoco, Dome and PanCanadian are among the larger operators whose plans may develop to the construction phase. This is a complex business, as LPG extraction generally has to wait on the gas market, so companies with LPG projects which do not have firm gas markets will not be in a position to go ahead with pipelines. Weighing the prospects, about 200 miles of LPG laterals might be expected.

One promising project that was once intended for a 1981 start is very unlikely. Interprovincial Pipe Line Ltd.'s proposed line from Norman Wells, Northwest Territories to Zama, Alberta, is stalled by interventions of public interest groups at the National Energy Board hearings, and is virtually out of the running for approval in time to do anything before 1982.

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Construction Report

Australia To Experience Pipeline Construction Boom

by **William A. Scholes**, *Australian Correspondent*

Australia's pipeline industry will find itself facing an unprecedented construction boom in 1981. The big increase in demand for natural gas requires an increase in pipeline construction. At least 10 different pipeline jobs will be under construction in Victoria and New South Wales in 1981:

Victoria

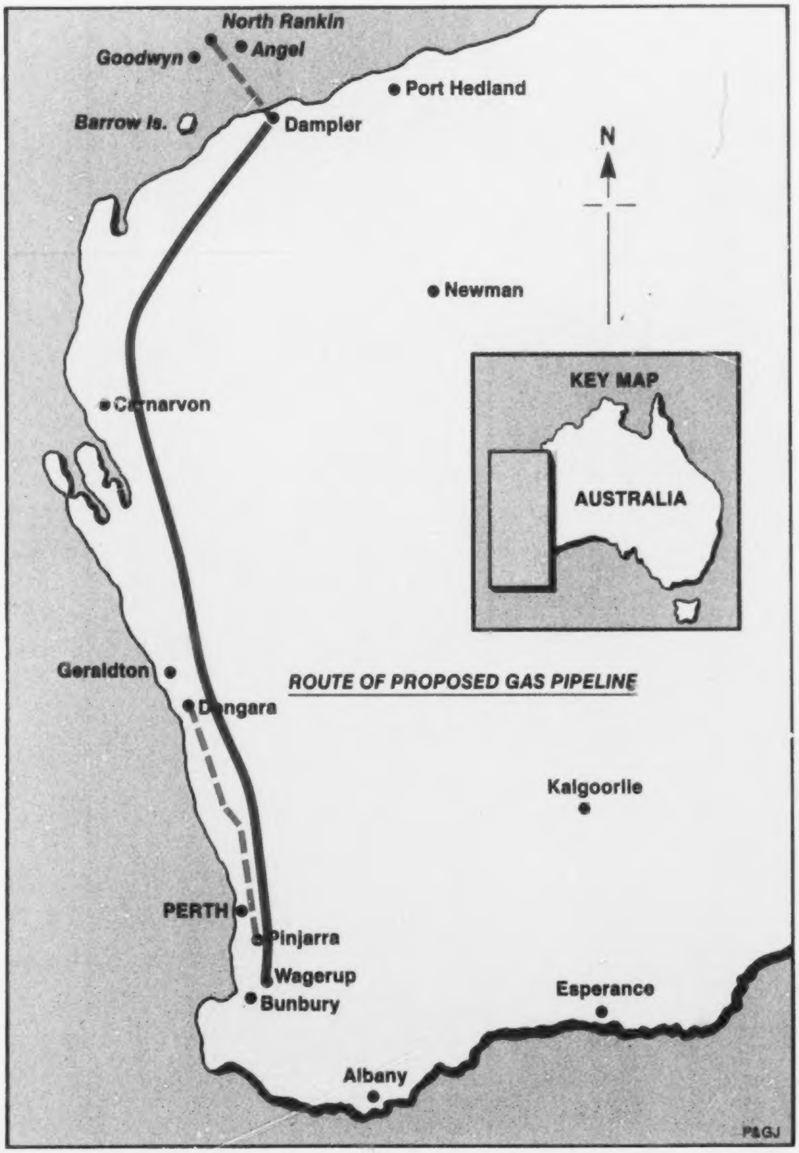
Company	Miles	Size (in.)	Type	Location
Esso Australia	55	28	Oil	Longford to Westbury.
Gas & Fuel Corp.	31.9	12	Gas	Mt. Franklin to Bendigo.
Gas & Fuel Corp.	15	12	Gas	Mt. Franklin to Kyneton.
Gas & Fuel Corp.	3.1	30	Gas	Dandenong.
Gas & Fuel Corp.	10	8	Gas	Shepparton to Tatura.

New South Wales

Company	Miles	Size (in.)	Type	Location
Aust. Gas Light Corp.	101.9	20	Gas	Plumpton to Hexham.
Newcastle Pipeline Co.	88.1	12	Products	Plumpton to Killingworth.
Hunter Pipeline Co.	15.6	14	Products	Silverwater to Plumpton.
Hunter Pipeline Co.	14.8	12	Products	Killingworth to Wickham.
Pipeline Authority	81.3	12	Gas	Young to Wagga.
Pipeline Authority	37.5	12	Gas	Dalton to Canberra.

Several projects are scheduled for construction later in 1981 and early 1982.

N.S.W. has pipeline projects under consideration and although the pipeline system to serve Orange, Bathurst, and Lithgow with natural gas has yet to be approved, it is only a matter of time.


North Rankin
Goodwyn
Angel
Port Hedland
Barrow Is.
Dampier
N
Newman
KEY MAP
AUSTRALIA
Carnarvon
Geraldton
Dongara
ROUTE OF PROPOSED GAS PIPELINE
Kalgoorlie
PERTH
Pinjarra
Wagerup
Bunbury
Esperance
Albany
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Map shows location of major gas line in Western Australia from Dampier area to Perth area and location of North West Shelf production and pipelines.

Supply of natural gas to both Newcastle and Canberra is also going to generate a good deal of pipeline work in both these areas.

Work available in these two states will keep pipelines busy during the period leading up to the start of Western Australia's huge Dampier-to-Perth gas pipeline. Start of construction on that line should get underway late 1981 or early 1982, to make natural gas available in the last quarter of 1984.

Northern Territory

The Northern Territory Government has commissioned studies for piping Palm Valley gas to major mining areas in the Northern Territory and to Darwin. The only definite pipeline proposal out of Palm Valley, though, is for a gas pipeline to Alice Springs.

The Northern Territory Electricity Commission commissioned a study, carried out by Pipeline Technologists, that recommends a 150 km (93.75-mile) pipeline of 6 to 8-in. diameter.

Estimates of gas reserves in the Palm Valley gas field in the Northern Territory have been increased more than tenfold to between 1.4 and 4 billion m^3.

The Palm Valley gas field has been the centre of many pipeline proposals. In 1973, Bechtel Corp. prepared a report suggesting piping gas to the coast and liquefying the gas for export. The Palm Valley gas field has also been proposed as the central link in a transcontinental pipeline from the Northern Territory Shelf to the Eastern States.

Melbourne "Outer Ring" Pipeline

The Gas Fuel Corporation of Victory plans to build a pipeline to take natural gas from Pakenham to Wollert in Victoria. The pipeline plan is known as Melbourne's Outer Ring Main. It will be 91 km (56.9 miles) and 30-in. diameter. Estimated cost of the pipeline is $A42 million.

The corporation said that the pipeline is needed to handle the increased demand for natural gas, which is causing overloading of the corporation's present transmission pressure system.

Unless corrective measures are taken, a critical situation will be reached whereby demand cannot be met. This is likely to occur initially in that section of the pipeline that traverses Melbourne's northern and western suburbs, particularly in the section between the offtakes to the country areas at Keon Park and Brooklyn.

Several projects currently underway will have the short term effect of deferring this critical low pressure situation. These projects include:

- Duplication of a short section of a 30-in. pipeline between the Dandenong City Gate station and the metropolitan ring pipeline at Henty St., Dandenong.
- Installation of a liquefied natural gas peakshaving plant at Dandenong.

A proposal to install compressors on the metropolitan ring pipeline was rejected because the cost benefit ratio was unfavorable, benefits would be short term only, and noise control difficulties would be encountered.

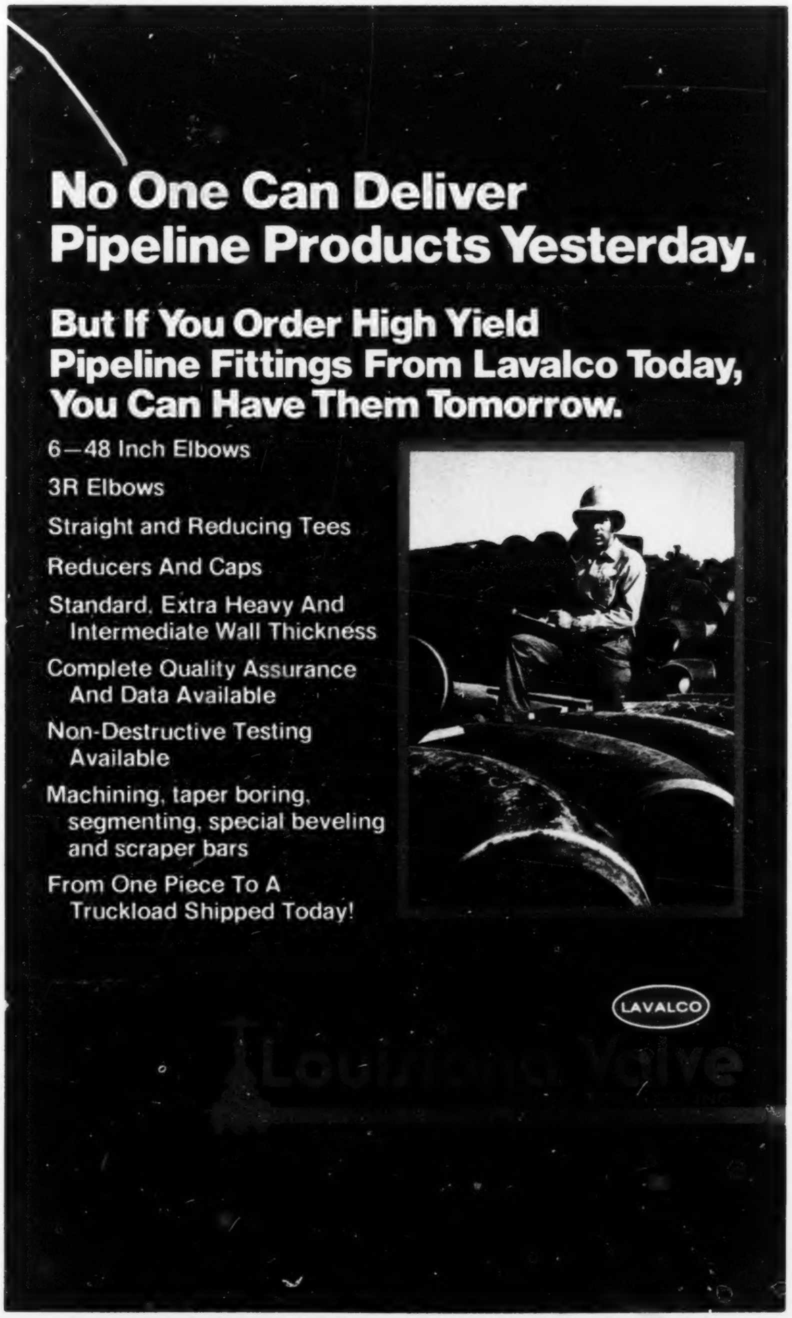
Upon completion of the two projects, the basic system will be operating at optimum capacity and cannot be upgraded in any significant way.

The corporation said the most efficient way to achieve their objective was to construct a pipeline from the Longford-Dandenong pipeline at Pakenham to the metropolitan ring pipeline in the vicinity of Keon Park.

Construction of the pipeline will be over three years commencing in 1983.

Western Australia

Now that the long-awaited official go-ahead has been given to the $A5000 million North West Shelf project, the Australian pipeline industry is on the verge of its busiest era.



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The latest technology will be required for the project's 134 km (84-mile) submarine pipeline from the North Rankin gas field and the WA State Energy Commission's 147 km (919 mile) onshore pipeline to the southwest.

Laying the submarine line in depths of up to 130 m in an area subject to cyclonic weather is expected to prove hazardous.

The onshore line, from the receival site at South Withnell Bay to the industrial centres of Perth, Kwinana and Wagerup will be the longest pipeline ever laid in the Southern Hemisphere.

The pipeline will require a work force of about 1650, in three separate units spread over the length of the route.

Woodside Petroleum Ltd., the company developing the North West gasfields, has timed the first phase of its project to begin pipeline sales to the southwest WA markets in 1984.

The liquefaction components of the project (liquefied natural gas and liquefied petroleum gas) are scheduled to begin in 1986.

The offshore pipeline system will run from the North Rankin A platform. Provision for inter-platform lines to North Rankin B and future platforms in other fields has also been made.

The trunkline from the platforms will be 40-in. diameter. The 1471 km onshore line will vary between 26 and 32-in.

A major aspect of the pipeline system design was the assessment of the feasibility of two-phase flow for the transportation of gas and condensate from North Rankin to shore.

The trunkline route was selected after hydrographic and soil surveys in 1978. The route generally follows a straight line from North Rankin A to the eastern side of the entrance to Mermaid Sound. Minor deviations to either side of the straight line route have been specified to minimize bottom roughness and to maximize the available sediment cover for burial of the pipe.

The pipeline passes through the eastern side of Mermaid Sound as far removed as practicable from the iron ore carrier anchorages, to a landfall south of Withnell Bay.

In addition to the hydrographic and soil studies, a 13-month oceanographic and meteorological data gathering program was conducted. Instrumentation was deployed at the platform areas, along with proposed pipeline route, and in Mermaid Sound, to provide continuous records of currents, waves, tides, water temperatures and salinity.

An extensive study was conducted to estimate extreme bottom currents caused by cyclones.

To meet the operational and constructional stresses in the pipeline, API 5LX 65 grade steel will be used, requiring wall thickness of 23.8 mm (0.937-in.).

In Mermaid Sound, where the pipeline runs close to the ore carriers holding area and where the relatively shallow areas may become a surf zone when a cyclone passes, pipe will be laid in a pre-dredged trench and back-filled with graded material after pipe lay is completed.

Further offshore trenching of the pipeline will be accomplished by conventional jet barge or the use of the newly-developed drenching plough.

In areas of outcropping rock where burial becomes impracticable, the pipeline will be stabilized by grout bags or rock armoring.

The Withnell Bay plant will produce four products, gas for WA (385 million cu ft per day), condensate (1.4 million tons per year), liquefied petroleum gas (640,000 tons a year) and liquefied natural gas (6 million tons a year).

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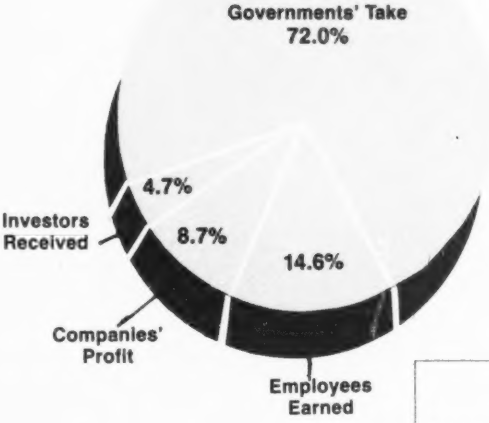
Governments Take 72%

by Ernestine Adams, *Editor, Energy Management Report*
and Julie Fonner, *Assistant Editor*



Governments are the winners, hands down, in oil company operations. In 1979, the 44 companies we surveyed for the fifth year, provided governments (local and national, U.S. and foreign) with a minimum 72% of their take from consumers.

This does not include government revenues from companies handling equipment, services and supplies and their stockholders and employees. They pay as much or more into government coffers as oil companies do.

Purchases of capital goods like refinery units and tanks, services like drilling and pipeline laying, supplies such as chemicals and pencils, make up a major part of an oil company's expense column.

The companies that provide those items are swamped by taxes which their customers have to cover.

"Windfall Profits" tax in the U.S. was not broken out because it did not operate for the full year. It is included in "Other Taxes." The sum of that column rose from $38.6 billion in 1978 to $55.7 billion in 1979.

Governments' take rose a couple of points. It was 70.2% in 1978. Other groups were down slightly percentage-wise, although actual figures were up over 1978.

WHO GOT WHAT FROM 44 OIL COMPANIES' OPERATIONS IN 1979

	COMPANY'S PROFIT	INVESTORS RECEIVED	EMPLOYEES EARNED	GOVERNMENTS' TAKE				
Company	Net income* after dividends ($000)	Dividends (common & preferred) ($000)	Payrolls & Benefits ($000)	Taxes on Dividends[1] ($000)	Taxes on employees' share[2] ($000)	Excise taxes on products[3] ($000)	Other taxes[4] ($000)	Total taxes ($000)
Amerada Hess	365,920	84,205	186,000[e]	16,841	62,000	98,000[e]	891,920	1,068,761
American Petrofina	32,759	25,214	81,525	5,043	27,175	46,741	74,277	153,236
Ashland Oil	387,315	69,469	524,862	13,894	174,954	266,496	333,227	788,571
Atlantic Richfield	508,761	337,492	1,122,400	67,498	374,133	442,718	1,429,506	2,313,855
Cities Service	159,100	94,200	481,000	18,840	160,333	144,800	382,900	706,873
Clark Oil & Refining	28,412	6,623	90,900	1,325	30,300	134,345	56,488	222,458
Coastal Corp.	77,983	11,249	163,000	2,250	54,333	48,200	82,600	187,383
Conoco Inc.	449,295	183,195	1,059,600	36,639	353,200	203,400	2,749,500	3,342,739
Crown Central Petr.	58,384	6,647	43,591	1,329	14,530	82,204	58,780	156,843
Crystal Oil	6,421	1,906	8,857	381	2,952	0	11,025	14,358
Diamond Shamrock	24,409	76,857	341,000	15,371	113,667	18,348	108,058	255,444
Dorchester Gas	25,105	47	10,946	10	3,649	646	32,747	37,052
Earth Resources	5,963	5,262	21,080	1,052	7,027	9,600	20,640	38,319
Exxon	857,063	1,719,090	4,182,000	343,818	1,394,000	4,448,582	16,906,707	23,093,107
Getty	373,331	116,087	353,765	23,217	117,922	154,787	1,109,787	1,405,713
Gulf Oil	518,000	402,000	1,481,000	80,400	493,667	1,983,000	2,404,000	4,961,067
Holly Corp.	7,023	0	9,402	0	3,134	6,000	5,125	14,259
Husky Oil Ltd.	70,104	11,498	95,400	2,300	31,800	68,600	65,126	167,826
Kerr-McGee Corp.	79,819	40,099	252,000	8,020	84,000	81,000	174,473	347,493
Louisiana Land & Expl.	64,210	52,417	62,819	10,483	20,940	0	164,853	196,276
Mapco Inc.	19,365	26,374	106,000	5,275	35,333	3,915	68,163	112,686
Marathon Oil	125,716	84,773	335,070	16,955	111,690	455,461	983,665	1,567,771
Marion Corp.	17,075	1,086	9,396	217	3,132	0	16,358	19,707
Mobil Corp.	925,556	540,801	3,603,000[e]	108,160	1,201,000	2,764,411	11,932,591	16,006,162
Murphy Oil	78,733	12,424	94,859	2,485	31,620	183,155	235,710	452,970
Occidental Petroleum	303,086	126,780	799,523	25,356	266,508	714	1,514,471	1,807,049
Pacific Resources	9,352	18,227	16,128	3,645	5,376	0	14,636	23,657
Pennzoil Co.	79,682	79,418	219,400	15,884	73,133	28,008	186,342	303,367
Phillips Petroleum	474,167	208,477	863,000	41,695	287,667	156,000	1,394,944	1,880,306
Quaker State	1,419	16,351	94,370	3,270	31,457	18,495	34,170	87,392
Shell Oil	481,159	322,201	1,173,000	64,440	391,000	790,822	1,090,056	2,336,318
Southern Union Co.	6,242	13,912	47,000	2,782	15,667	429	38,190	57,068
Standard California	794,770	494,962	1,120,000	98,992	373,333	990,863	2,347,023	3,810,211
Standard Indiana	621,358	442,630	1,287,854	88,526	429,285	1,267,400	2,016,970	3,802,181
Standard Ohio	892,180	146,968	541,071	29,394	180,357	305,726	1,009,729	1,525,206
Sun Co.	354,700	172,600	979,300	34,520	326,433	459,400	716,200	1,536,553
Tenneco	21,000	259,000	1,500,000[e]	51,800	500,000	260,000	325,000	1,136,800
Tesoro Petroleum	40,189	9,565	61,522	1,913	20,507	20,000	44,988	87,408
Texaco Inc.	608,153	575,458	1,701,800	115,092	567,267	3,116,214	3,770,800	7,569,373
Tipperary Corp.	2,321	0	3,934	0	1,311	0	1,573	2,884
Texas Eastern Corp.	37,336	80,362	120,015	16,072	40,005	0	270,156	326,233
Tosco Corp.	78,028	1,108	92,230	222	30,743	102,428	86,322	219,715
Union California	275,404	112,600	486,300	22,520	162,100	400,852	545,000	1,130,472
United Refining	12,953	2,111	22,906	422	7,635	67,953	17,731	93,741
TOTAL	10,359,321	6,991,745	25,848,825	1,398,348	8,616,275	19,629,713	55,722,527	85,366,863

[1] Taxes on dividends are 1/5; inflation increases tax without a rate increase. [2] Employees' taxes are estimated at 1/3, calculated by Taxpayers' Foundation as the average rate for employed persons. [3] U.S. federal excise tax is 4¢/gallon on gasoline in 1979; state taxes averaged about 8¢/gallon. Other products have lower excise tax. [4] Taxes levied directly on companies: Income taxes (before dividends), property taxes, severance taxes on oil/gas production, sales taxes on goods purchased, tariffs, and "Windfall Profits Taxes." *Excluding non-recurring items. [e] Estimate.

PROFESSIONAL OPPORTUNITIES

"If output is to grow, one of productivity's vital ingredients, the input of energy, must be available and usable," President John F. Bookout of Shell Oil told a faculty group last spring.

There is no statistical link between energy and productivity but you can see a logical tie. With no energy to run an economy, you have no modern economy.

It is obvious also that productivity of the American worker, and those of other nations, has declined since energy was controlled. In the 1947-1967 period an annual gain of 3.7% was recorded in the U.S. From 1967-1977 average increase came down to 1.8%.

Last year and most of this year the figures see-sawed downward, putting the U.S. in the minus column. Productivity dropped in second quarter of 1980 by an annual rate of 1.9% after a decline of 0.6% in first quarter. That was the sixth decrease in succession. Labor Dept. said U.S. business had a 2.6% rise in productivity for the third quarter.

Company	Professional* Employees 1979	1978	1977
Adams Res. & Energy	150	100	
Altex Oil	3	4	
Amarex Inc.	26	31	34
Amcole Energy	6	12	
Argonaut Energy	13	12	9
Argo Petroleum	22	25	25
Ashland Oil	6,535	7,107	7,296
Brock Exploration	20	20	12
C&K Petroleum	46	40	
Centura Energy	23	23	
Columbia Gas	1,022	1,022	1,022
Commonwealth N.R.	52	52	52
Commonwealth OR	459	416	438
Consolidated N.G.	1,675		
Consolidated O&G	16	9	7
Crystal Oil	229	198	142
Energy Reserves Gp.	220	200	170
Enserch Corp.	7,095	6,263	5,419
Felmont	35	39	37
Forest	250	250	
Galaxy Oil	13	10	12
Hadson Petroleum	24	19	
Helmerich & Payne	194	169	154
Howell Corp.	60	150	140
Inexco Oil	70	60	50
Juniper Petroleum	24	24	21
Louisiana L&E	301		
MGF Oil	80	60	
Mapco Inc.	500	390	350
Marion Corp.	42	36	34
May Petroleum	24	21	8
McMoRan Oil & Gas	105	63	38[e]
Mesa Petroleum	84	75	56
Mitchell Energy	633	575	525
Noble Affiliates	165	150	
Peninsula Resources	12	10	
Petro-Lewis	417	326	246
Phillips Petroleum	7,820	7,150	6,670
Pioneer Corp.	546	530	519
Quaker State	500	515	485
Sabine Corp.	70	60	40
Southland Royalty	199	258	224
Sundance Oil	16		
Supron Energy	56	51	45
Tesoro Petroleum	660	683	717
Texas American	21	18	16
Texas Eastern	650	634	568
Transco Companies	825	745	653
Tribune Oil	3	3	3
United Energy Res.	1,063	923	806
Universal Resources	45	44	35
Vanderbilt Energy	12	10	7
Woods Petroleum	62	67	57
Worldwide Energy	20	20	20
TOTAL	30,426	28,993	27,154

[e] Estimate. *Managers, lawyers, engineers, geologists, accountants, scientists, etc.

An associate director of Commerce Dept.'s Bureau of Economic Analysis puts it succinctly: "Productivity has gone to pot since 1973."

The energy industry needs an influx of professionals--managers, geologists, engineers (all kinds)--and without them we can't get the economy off the ground. Energy operations always need special technology and today it needs it more than ever.

Consulting services here and in other industrialized nations are esstenial to devise plans for oil and gas operations in states where politicians run the energy business.

In earlier days coal ran the economy of industrial states. Now coal industry is limited by deterioration of infrastructure and environmental laws. Getting coal out of the ground and to market is work too hard for current laborers.

Coal is found in every continent, but the U.S. is estimated to have the largest reserves. It is being exported from U.S., however, because regulations have discouraged use. Transportation problems and lack of ports hold down production.

When chief executives of national oil firms from Organization of Petroleum Exporting Countries members met in Vienna, main topics included manpower evaluation and on-the-job training. U.S. problems are multiplied in other countries.

And the U.S. does have shortage problems of professionally trained and experienced people. Some executives wonder if the synfuels program, which will require squadrons of engineers and scientists, can operate with the present supply.

Says one man who should know, "The work load for engineers is going to double."

What this section will strive for is to help fill jobs that increase energy, which will, in turn, increase the hum of the economy.

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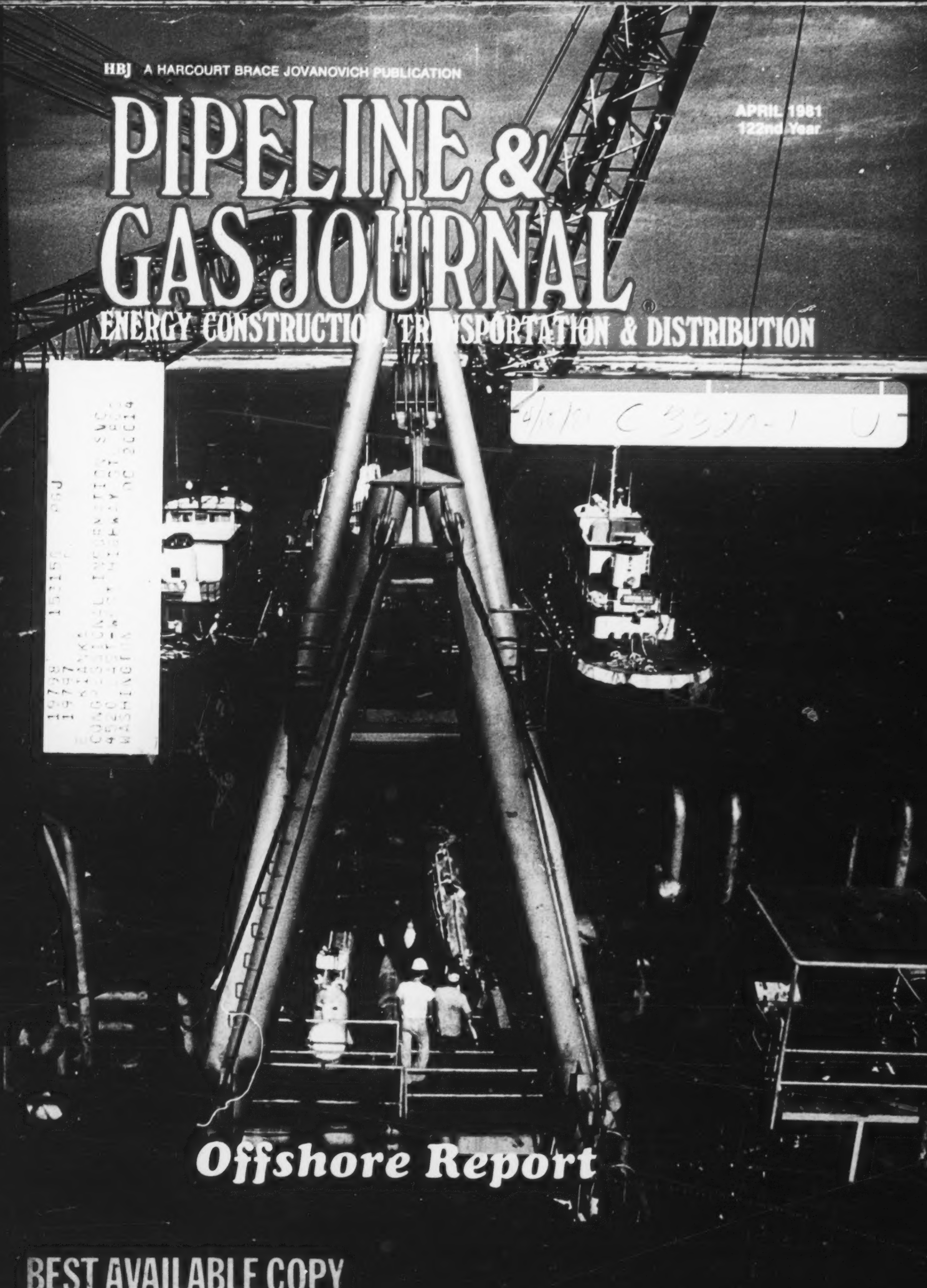

Offshore Report

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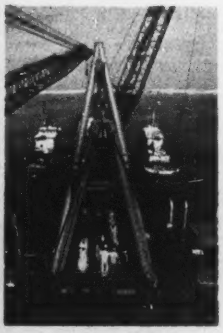

COVER
Pipe for the Padre Island Offshore Texas Gas Pipeline, installed for Valley Pipe Lines, slips off back of McDermott's LB-23 barge during laying operations in Gulf of Mexico.

—Photo Courtesy Houston Natural Gas Co.

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4th Quarter Report

Profit Margin Dips Despite Record Revenues

Rising prices for crude oil, refined products and natural gas were the biggest factor in an overall 26.6% increase in 1980 earnings over 1979 results for 70 oil companies.

Slack demand for refined products and high inventories in second half of 1980 hurt refining and marketing operations. Product prices in virtually all U.S. markets failed to keep pace with rising crude oil costs. As a result, the companies' net income in fourth quarter rose only 1% over same quarter of 1979.

Though many firms reported record revenues and earnings, the group's overall profit margin for 1980 was 5.6%, down from 5.8% in 1979.

Oil/gas production was the main profit maker for integrated oil firms and for some gas utilities. "Windfall profits" tax, applied to almost all U.S. oil production after March 1, penalized independents with a high ratio of domestic oil output

Texaco's 12-month earnings rose but fourth quarter net dropped from same 1979 period. Downstream operations declined in U.S. due to lower margins, but rose internationally.

Exxon said higher prices led to greater net on production, although gas sales fell 7%. Higher refined product margin for 12-month period more than offset a 10% decline in sales volume.

Standard California had higher domestic gas production. Despite fourth quarter slump, refining and marketing earnings for full year were higher than in 1979. Higher prices offset lower margins on product sales internationally.

Mobil received higher prices on lower volumes of product sales. Worldwide chemical sales rose. Foreign inventory profits were $344 million higher than in 1979.

Energy production earnings rose about 33% for Gulf in 1980, though fourth quarter net fell as refining/marketing and chemicals slumped.

Conoco's international oil/gas earnings benefited from higher crude oil margins and production in North Sea, but margins and volumes fell in Libya, and U.S. income taxes were higher.

Higher oil prices, greater output from North Slope of Alaska and strong refining operations in first half caused Atlantic Richfield's income gain.

Union Oil had higher margins in domestic refining/marketing and higher chemical earnings as well as more oil/gas production income.

Greater liquids production overseas and higher prices were responsible for Standard Indiana's income gain, partially offset by lower refined product margins, lower chemical earnings, lower domestic oil/gas output.

Worldwide liquids output rose for Phillips Petroleum, but earnings from refining/marketing and chemicals fell below 1979 levels.

Net income in U.S. more than doubled for Marathon Oil, while earnings from foreign sources plummeted. Higher production revenues offset lower demand for products and higher exploration costs.

Tosco had net loss in fourth quarter and 12-month earnings fell from the previous year. Sharp increases in crude oil costs couldn't be passed through to customers because of high inventories of products.

Natomas had record earnings in all divisions: oil/gas production, marketing, geothermal and coal mining. Mapco cited higher prices from decontrol of gas liquids and record coal production.

Earnings for the group of large

FOURTH QUARTER GAS COMPANY FINANCIAL REPORTS

	Three months ending December 31**						Twelve months ending December 31**					
	Revenues ($000)			Earnings* ($000)			Revenues ($000)			Earnings* ($000)		
Company	1980	1979	% Chg.	1980	1979	% Chg.	1980	1979	% Chg.	1980	1979	% Chg.
Alabama Tennessee N.G.	27,067	19,838	+ 36.4	1,589	1,073	+ 48.1	91,907	69,878	+ 31.5	5,266	4,893	+ 7.6
American Natural Res.	969,920	797,528	+ 21.6	57,884	60,969	- 5.1	3,038,546	2,505,622	+ 21.3	113,219	148,654	- 23.8
Arkansas Louisiana Gas	240,223	196,546	+ 22.2	6,266	8,738	- 28.3	974,510	735,302	+ 32.5	73,334	60,741	+ 20.7
Columbia Gas	1,037,178	872,689	+ 18.8	56,234	42,450	+ 32.5	3,636,507	2,851,733	+ 27.5	165,311	143,113	+ 15.5
Commonwealth N.G.	61,352	47,566	+ 29.0	1,423	1,360	+ 4.6	211,232	154,318	+ 36.9	6,035	5,448	+ 10.8
Consolidated N.G.	751,748	640,760	+ 17.3	41,446	37,843	+ 9.5	2,503,054	2,045,947	+ 22.3	113,008	122,823	- 8.0
El Paso Companies	928,106	792,264	+ 17.1	30,534	31,971	- 4.5	3,543,436	2,663,809	+ 33.0	108,889	110,725	- 1.7
Enserch Corp.	694,734	597,799	+ 16.2	34,807	21,249	+ 63.8	2,694,933	2,238,216	+ 20.4	139,583	84,535	+ 65.1
Houston N.G.[1]	653,253	561,371	+ 16.4	54,052	43,394	+ 24.6	2,449,754	2,006,622	+ 22.1	206,848	151,100	+ 36.9
InterNorth	907,514	775,687	+ 17.0	42,559	55,757	- 23.7	3,037,764	2,499,202	+ 21.5	211,722	185,538	+ 14.1
Mountain Fuel Supply	113,398	98,259	+ 15.4	8,642	9,281	- 6.9	406,189	334,789	+ 21.3	30,851	25,540	+ 20.8
Northwest Energy	396,099	384,879	+ 2.9	16,049	14,697	+ 9.2	1,323,432	1,119,532	+ 18.2	51,347	41,267	+ 24.4
Oneok Inc.	329,143	245,344	+ 34.2	6,844	4,621	+ 48.1	943,853	735,879	+ 28.3	42,075	31,244	+ 34.7
Pacific Lighting	950,262	703,085	+ 35.2	38,017	17,072	+122.7	3,401,903	2,244,279	+ 51.6	101,129	92,071	+ 9.8
Panhandle Eastern	718,143	549,707	+ 30.6	40,588	23,357	+ 73.8	2,472,235	1,967,657	+ 25.6	181,959	146,184	+ 24.5
Peoples Energy[2]	828,947	752,690	+ 10.1	40,272	39,674	+ 1.5						
Pioneer Corp.	232,063	200,248	+ 15.9	23,962	17,016	+ 40.8	911,989	732,486	+ 24.5	90,556	65,631	+ 38.0
Southern Natural Res.	469,385	431,644	+ 8.7	35,155	25,917	+ 35.6	1,798,723	1,492,222	+ 20.5	139,257	109,415	+ 27.3
Texas Eastern Corp.	1,155,830	868,498	+ 33.1	58,812	46,131	+ 27.5	4,272,854	2,939,055	+ 45.4	219,757	177,104	+ 24.1
TransCanada PipeLines	946,025	797,963	+ 18.6	26,339	24,324	+ 8.3	3,143,382	2,580,972	+ 21.8	93,435	87,168	+ 7.2
Transco Companies	819,622	468,944	+ 74.8	31,729	22,384	+ 41.7	2,627,787	1,528,108	+ 72.0	112,506	68,361	+ 64.6
Union Gas Ltd.	247,056	195,962	+ 26.1	7,974	4,164	+ 91.5						
United Energy Res.	1,113,433	957,788	+ 16.3	48,334	28,380	+ 70.3	4,135,342	3,133,654	+ 32.0	165,454	111,687	+ 48.1
TOTAL	14,590,501	11,957,059	+ 22.0	709,511	581,822	+ 22.0	47,619,332	36,579,282	+ 30.2	2,371,541	1,973,242	+ 20.2

**Excluding non-recurring items. *Earnings available to common stock. [1]Ends October 31. [2]Ends September 30.

gas companies surveyed by EMR rose 20.2% over the previous year but trailed revenue gains.

Most gains in net income continue to come from non-regulated operations, especially oil/gas production, gas processing, NGL sales and contract drilling. Decontrol of gas liquids prices (except propane) on Jan. 1, 1980 boosted earnings. Even though new natural gas customers are being added in most parts of U.S., gas sales are essentially flat due to conservation by existing customers.

Income rose for Consolidated Natural Gas, spearheaded by oil/gas production, which offset the effects of recession, conservation and suspension of LNG operations at Cove Point, MD.

Oneok's healthy earnings gain was mainly due to non-utility operations—production, NGL extraction, contract drilling. Same factors boosted income of Pioneer Corp.

Non-utility business, including real estate and energy-related activities, accounted for most of the improvement in Pacific Lighting Corp.'s income.

Net income fell for Peoples Energy Corp.'s natural gas pipeline unit, but rose for the firm's contract drilling unit.

Record earnings for InterNorth were mainly due to its liquid fuels group, which benefited from higher prices.

United Energy Resources had higher gas sales, more oil/gas production and healthy drilling and well servicing operations.

El Paso said higher profits from oil/gas production were more than offset by lower chemical profits and loss from discontinued LNG operations. The company will write down the investment in its LNG tanker fleet.

FOURTH QUARTER OIL COMPANY FINANCIAL REPORTS

	Three months ending December 31**						Twelve months ending December 31**							
	Revenues ($000)			Earnings* ($000)			Revenues ($000)			Earnings* ($000)			Profit Margin#	
Company	1980	1979	% Chg.	1980	1979	% Chg.	1980	1979	% Chg.	1980	1979	% Chg.	1980	1979
§Adams Resources & Energy	68,807	54,443	+ 26.4	1,123	740	+ 51.8	241,163	178,893	+ 34.8	(3,037)	4,439			2.5
Altex Oil	374	213	+ 75.6	168	48	+250.0	1,074	734	+ 46.3	184	(227)		17.1	
American Petrofina	613,450	457,551	+ 34.1	19,315	17,707	+ 9.1	2,098,464	1,587,229	+ 32.2	104,279	83,187	+ 25.4	5.0	5.2
Argonaut Energy	1,047	717	+ 46.0	96	118	- 18.6	2,648	1,930	+ 37.2	167	(3)		6.3	
§Ashland Oil	1,969,400	1,928,500	+ 2.1	20,200	75,900	- 73.4	8,159,300	7,245,700	+ 12.6	149,500	551,400	- 72.9	1.8	7.6
Asamera	99,416	72,976	+ 36.2	3,516	2,178	+ 61.4	269,071	192,157	+ 37.9	7,923	9,280	- 14.6	2.9	4.8
§Atlantic Richfield	7,483,382	4,987,482	+ 50.0	398,279	342,958	+ 16.1	24,578,042	16,818,324	+ 46.1	1,651,423	1,165,894	+ 41.6	6.7	6.9
Belco Petroleum	222,325	202,446	+ 9.8	22,650	24,900	- 9.0	836,933	643,503	+ 30.1	77,893	79,036	- 1.4	9.3	12.3
Brock Exploration	1,978	1,631	+ 21.3	371	428	- 13.3	5,596	3,821	+ 46.5	1,259	896	+ 41.4	22.5	23.4
Callon Petroleum[2]	1,898	1,721	+ 10.9	202	364	- 44.5	8,488	4,628	+ 83.4	1,358	911	+ 49.1	16.0	19.7
Centura Energy	7,510	5,647	+ 33.0	285	184	+ 54.9	10,147[1]	7,731[1]	+ 31.3	151[1]	64[1]	+135.9	1.5	0.8
Clark Oil & Refining	400,742	332,017	+ 20.7	4,324	13,170	- 67.2	1,657,635	1,175,015	+ 41.1	43,920	41,658	+ 5.4	2.7	3.5
§Conoco Inc.	5,240,000	3,795,700	+ 38.1	240,600	190,700	+ 26.2	18,766,300	13,082,900	+ 43.4	1,026,200	815,400	+ 25.9	5.5	6.2
Crown Central Petroleum	313,748	327,211	- 4.1	3,868	19,445	- 80.1	1,266,898	1,054,771	+ 20.1	19,147	71,678	- 73.3	1.5	6.8
Crystal Oil	84,139	53,585	+ 57.0	310	4,152	- 92.5	273,164	164,898	+ 65.7	10,690	10,233	+ 4.5	3.9	6.2
Delhi International Oil	7,399	5,319	+ 39.1	960	878	+ 9.3	27,138	17,594	+ 54.2	4,784	3,590	+ 33.3	17.6	20.4
Diamond Shamrock	848,100	671,381	+ 26.3	45,917	58,507	- 21.5	3,145,720	2,356,858	+ 33.5	201,214	178,123	+ 13.0	6.4	7.6
Exeter Oil	1,434	1,125	+ 27.5	248	391	- 36.6	4,461	2,700	+ 65.1	1,129	800	+ 41.1	25.3	29.6
Exxon	29,847,000	25,820,000	+ 15.6	1,350,000	1,365,000	- 1.1	110,469,000	84,968,000	+ 30.0	5,660,000	4,295,000	+ 31.8	5.1	5.1
Felmont	15,218	10,251	+ 48.5	1,982	2,827	- 29.9	57,441	40,272	+ 42.6	13,697	9,351	+ 46.5	23.8	23.2
Galaxy Oil[2]	3,011	2,151	+ 39.9	61	62	- 1.6								
General American	75,765	57,117	+ 32.6	10,499	15,214	- 31.0	273,448	192,599	+ 42.0	54,131	46,685	+ 15.9	19.8	24.2
§Getty Oil	2,966,250	1,546,526	+ 91.8	210,857	182,330	+ 15.6	10,436,827	5,120,739	+103.8	870,847	603,363	+ 44.3	8.3	11.8
Gulf Energy & Develop.	18,685	10,922	+ 71.1	1,989	2,117	- 6.0	50,486	33,544	+ 51.0	6,728	5,552	+ 21.2	13.3	16.6
Gulf Oil Corp.	7,603,000	7,730,000	- 1.6	304,000	366,000	- 16.9	28,790,000	26,140,000	+ 10.1	1,407,000	1,322,000	+ 6.4	4.9	5.1
Helmerich & Payne	66,217	46,862	+ 41.3	15,398	10,452	+ 47.3								
Houston O&M	125,323	86,746	+ 44.5	33,186	23,666	+ 40.2	382,987	300,624	+ 27.4	79,550	65,651	+ 21.2	20.8	21.8
Inexco Oil	39,220	29,751	+ 31.8	5,190	5,372	- 3.4	146,606	103,249	+ 42.0	22,576	17,504	+ 29.0	15.4	17.0
Kerr-McGee Corp.	949,371	755,470	+ 25.7	51,791	40,396	+ 28.2	3,477,881	2,683,469	+ 29.6	182,223	160,017	+ 13.9	5.2	6.0
Lear Petroleum	27,109	22,858	+ 18.6	2,304	1,760	+ 31.0								
Louisiana L&E	305,100	246,352	+ 23.8	48,227	44,313	+ 8.8	1,075,771	817,014	+ 31.7	180,162	169,044	+ 6.6	16.7	20.7
Mapco Inc.	532,864	439,092	+ 21.4	28,969	30,765	- 5.8	1,769,740	1,261,443	+ 40.3	122,260	88,600	+ 38.0	6.9	7.0
§Marathon Oil	2,420,748	2,220,287	+ 9.0	55,273	54,261	+ 1.9	8,754,198	7,199,522	+ 21.6	379,016	323,222	+ 17.3	4.3	4.5
Marion Corp.	137,986	91,396	+ 51.0	7,317	6,298	+ 16.2	470,266	300,070	+ 56.7	22,420	19,879	+ 12.8	4.8	6.6
May Petroleum	8,227	3,301	+149.2	1,235	759	+ 62.7	24,675	13,846	+ 78.2	4,524	2,325	+ 94.6	18.3	16.8
McMoRan Oil & Gas	13,614	10,062	+ 35.3	1,326	874	+ 51.7	27,011[1]	17,643[1]	+ 53.1	9,334[1]	1,750[1]	+433.4	34.5	9.9
Mesa Petroleum	86,747	72,147	+ 20.2	33,979	16,361	+107.7	331,799	258,106	+ 28.6	95,236	54,203	+ 75.7	28.7	21.0
§Mobil Corp.	17,314,000	14,815,000	+ 16.9	565,000	538,000	+ 5.0	63,652,000	48,292,000	+ 31.8	2,819,000	2,007,000	+ 40.5	4.4	4.2
Murphy Oil	537,054	416,898	+ 28.8	45,610	38,021	+ 20.0	2,016,752	1,595,919	+ 26.4	150,547	103,581	+ 45.3	7.5	6.5
§Natomas Energy	193,600	137,700	+ 93.6	49,700	20,500	+142.4	792,000	492,000	+ 61.0	187,700	75,500	+148.6	23.7	15.3
Noble Affiliates	71,246	61,942	+ 15.0	13,092	11,170	+ 17.2	276,561	213,838	+ 29.3	47,199	33,041	+ 42.8	17.1	15.5
Occidental Petroleum	3,179,600	2,866,600	+ 10.9	138,100	186,800	- 26.1	12,476,100	9,554,800	+ 30.6	710,800	561,600	+ 26.6	5.7	5.9
Patrick Petroleum	16,839	8,369	+101.2	1,360	(358)		54,784	36,342	+ 50.7	3,209	1,701	+ 88.6	5.9	4.7
Peninsula Resources	4,669	3,027	+ 54.2	504	208	+142.3	15,609	10,397	+ 50.1	1,555	495	+214.1	10.0	4.8
Pennzoil Co.	659,422	603,064	+ 9.3	76,384	72,008	+ 6.1	2,483,015	2,051,693	+ 21.0	304,076	233,789	+ 30.1	12.2	11.4
Petroleum Development	1,422	3,795	- 62.5	142	171	- 17.0	12,430	10,301	+ 20.6	1,054	888	+ 18.6	8.5	8.6
Petro-Lewis	46,314	25,271	+ 83.3	8,184	3,274	+150.0	87,065[1]	48,321[1]	+ 80.2	15,516[1]	7,179[1]	+116.1	17.8	14.9
Phillips Petroleum	3,874,418	3,044,789	+ 27.2	286,973	306,491	- 6.4	13,712,879	9,744,750	+ 40.7	1,069,614	891,121	+ 20.0	7.8	9.1
Quaker State	222,065	178,494	+ 24.4	5,463	5,064	+ 7.9	832,494	691,641	+ 20.4	27,775	34,121	- 24.5	3.1	4.9
Seneca Oil[3]	3,783	917	+312.5	1,559	131	+1090.0	8,591	2,538	+238.5	2,220	178	+1147.2	25.8	7.0
Shell Oil	5,130,200	4,301,300	+ 19.0	408,600	331,200	+ 23.0	19,958,700	14,546,200	+ 37.0	1,541,600	1,125,600	+ 37.0	7.7	7.7
Southland Royalty	84,491	76,230	+ 14.8	9,924	16,962	- 70.9	366,571	256,611	+ 30.0	62,289	54,752	+ 12.1	17.0	21.3
§Standard California	10,834,000	9,543,000	+ 13.5	615,000	524,000	+ 17.3	41,553,000	30,938,000	+ 34.3	2,401,000	1,785,000	+ 34.5	5.8	5.8
§Standard Indiana	7,700,000	6,100,000	+ 26.2	402,200	368,700	+ 9.1	27,800,000	20,200,000	+ 37.6	1,915,300	1,506,600	+ 27.1	6.9	7.5
Statex Petroleum[4]	2,748	1,272	+116.0	988	206	+379.6	7,457	4,224	+ 76.5	1,862	787	+136.6	25.0	18.6
Sun Co.	4,100,000	3,200,000	+ 28.1	29,600	222,900	- 86.7	13,200,000	10,800,000	+ 22.2	722,800	699,900	+ 3.3	5.5	6.5
Superior Oil	440,720	302,625	+ 45.6	97,203	47,682	+103.9	1,497,695	1,085,394	+ 40.0	334,458	200,287	+ 67.0	22.3	18.5
Supron Energy	19,979	14,053	+ 42.2	6,406	4,796	+ 33.5	66,166	48,142	+ 37.4	20,093	14,420	+ 39.3	30.3	30.0
Tenneco	3,641,000	3,269,000	+ 11.4	200,000	164,000	+ 21.9	13,226,000	11,209,000	+ 18.0	726,000	571,000	+ 27.1	5.5	5.1
Tesoro	865,700	1,032,191	- 16.1	23,041	34,359	- 32.9	3,408,197	3,107,459	+ 9.7	82,572	72,096	+ 14.5	2.4	2.3
Texaco	14,058,300	12,012,200	+ 17.0	500,300	534,300	- 6.3	52,485,900	39,095,500	+ 34.3	2,240,200	1,759,100	+ 27.4	4.3	4.5
Texas Oil & Gas[2]	344,137	267,740	+ 29.0	40,365	29,259	+ 38.0	1,267,187	1,000,132	+ 26.7	152,222	107,266	+ 41.9	12.0	10.7
Tipperary Corp.	23,355	19,348	+ 20.7	1,944	2,734	- 28.9	91,801	66,685	+ 37.7	5,554	6,564	- 15.4	6.1	9.8
Tosco Corp.	680,642	549,185	+ 23.9	(9,837)	24,556		2,387,241	1,922,237	+ 24.2	46,096	78,028	- 40.9	1.9	4.1
Transcontinental Oil	20,668	17,999	+ 14.8	1,435	(134)		77,050	63,901	+ 20.6	2,395	(3,670)		3.1	
Union California	2,592,700	2,215,200	+ 17.0	177,249	152,305	+16.4	10,051,995	7,680,952	+ 30.9	647,000	500,604	+ 29.2	6.4	6.5
United Refining							664,370	502,917	+ 32.1	3,947	17,175	- 77.0	0.6	3.4
Universal Resources[4]	11,401	8,880	+ 28.4	2,352	1,102	+113.4	38,899	26,461	+ 47.0	7,222	2,929	+146.6	18.6	11.1
Wiser Oil	17,125	13,326	+ 28.6	6,386	4,928	+ 29.6	61,078	40,599	+ 50.4	17,911	13,258	+ 35.1	29.3	32.7
Woods Petroleum	14,588	11,838	+ 23.2	4,474	3,081	+ 45.2	64,683	43,159	+ 49.9	22,568	12,189	+ 85.2	34.9	28.3
TOTAL	139,312,790	117,222,209	+ 18.8	6,635,716	6,570,011	+ 1.0	512,584,648	389,371,639	+ 31.6	28,701,242	22,674,584	+ 26.6	5.6	5.8

**Excluding non-recurring items. *Earnings available to common stock. #Earnings* divided by Revenues = Profit Margin. () Loss. §Revenues include excise taxes. [1]Six months. [2]Ends Nov. 30. [3]Ends Sept. 30. [4]Ends Oct. 31.

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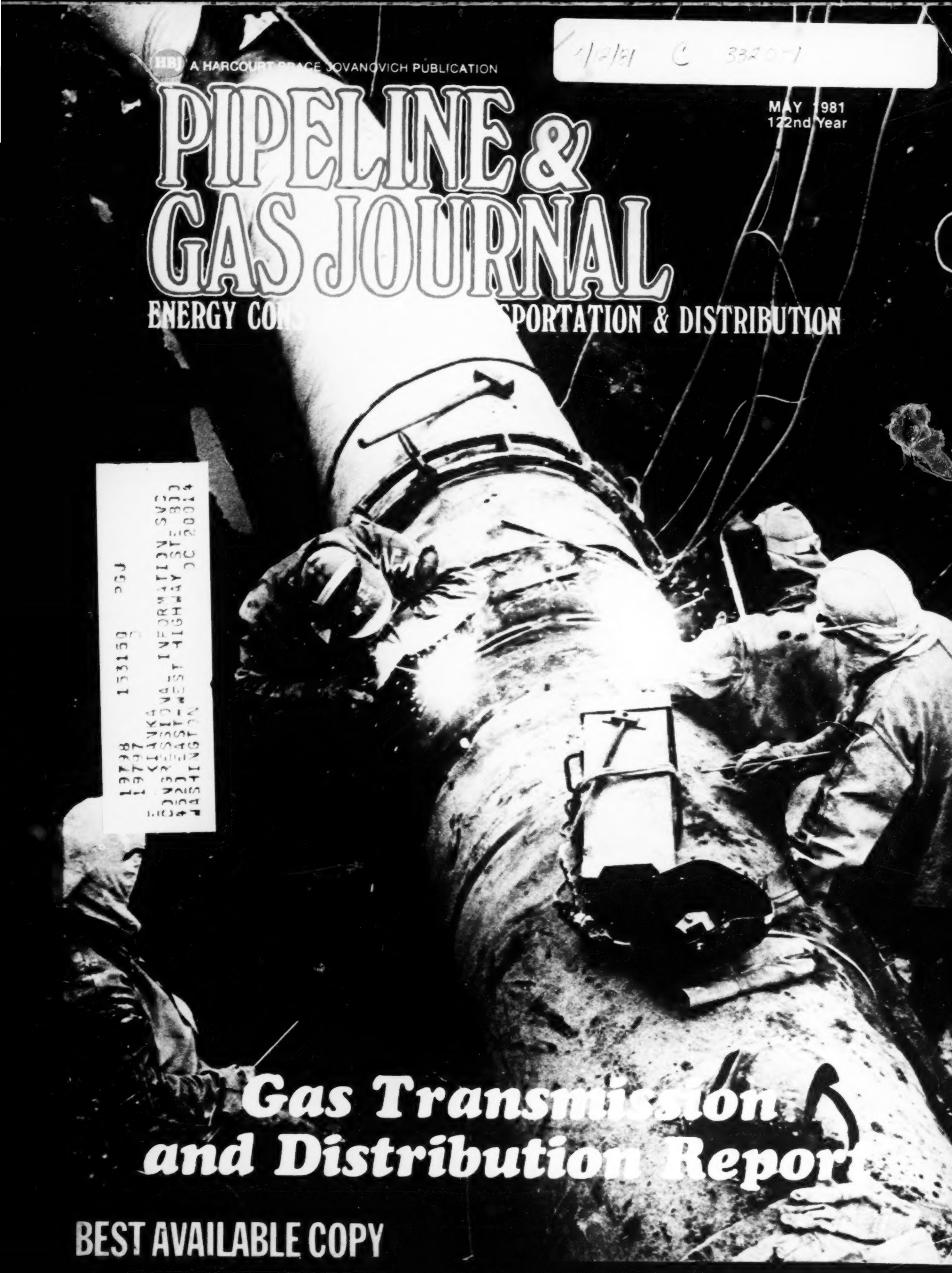

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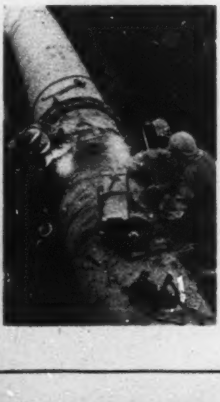

COVER
Weldors lay in filler passes on 36-in. pipe laid as tie-in section for road crossing in the area near LeMans; line runs 146 km to Nozay compressor station.

—photo courtesy Philips Welding Industries B.V.

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British Gas Installs Major 42-In. Line In Record Time 25
British Gas Co. has put into service its fourth St. Fergus Feeder—a 283-mile, 42-in. gas line to carry North Sea gas southward toward England only nine months after construction began.

PSE&G To Use Programmable Remote Terminal Operations 32
Public Service Electric & Gas Co. of New Jersey will bring its new SCADA (systems communications and data acquisition) network online by midyear.

GRI Distribution Research Improves Reliability, Safety 42
Despite excellent safety record, gas distribution industry continues to look for ways to improve that record; Gas Research Institute provides the scientific support.

Exacting Weather Outlooks Help Optimum Long Range Planning 48
Large savings may be realized through the use of high performance weather outlooks; a pioneer in the field tells how it is done.

Utilities Find Large Benefits In Using CNG As Vehicle Fuel 52

Shrinkwrapping Protects Meters In Transit, Cuts Costs 58

Gaz de France Adopts Low Hydrogen, Downhill Welding 60
Downhill low hydrogen welding is now routine on Gaz de France projects, increasing welding speeds and weldors' productivity.

Geotechnical Engineering: How To Use It 66
Part 3 of three-part series discusses use of geotechnical engineering in planning, designing, and constructing pipelines.

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Roc-Saw Chews Its Way To Trenching Success 96

CAPITAL EXPENDITURES INCREASE

FORECASTERS WALK ON SHAKY GROUND and never have indicators been more vacillating than today. This year and next U.S. will have the heaviest investments, mostly in exploration and development. Foreign exploration and development will balloon in the future when oil-exporting nations realize that finding and developing oil must continue indefinitely.

Algeria and Libya have proclaimed the need for foreign technology and demanded training for their people and technical aid in return for oil. They receive training and technical management but when foreigners leave, so goes the will and ability to operate the industry.

Atlantic Richfield cancelled two Nigerian contracts this year, an instant picture of the oil glut. There could be more cancellations, especially if the all-out exploration and drilling programs in the U.S. are half-way successful. Ashland reportedly stopped buying 90,000 b/d oil from Mexico and 17,000 b/d from Cameroon at quarterly review time. It seems the company has adequate and better supplies at lower rates.

Saudi Arabia has been telling OPEC for years the members would get in a bind with their headlong race for ever higher prices. Now it appears the chips are down and Saudi is prepared to rule the cartel. Saudi has been smart enough to keep Aramco, the only continuous oil operations management in place since 1948.

One factor that will create high capital expenditures and small profit, or losses, is OPEC members' determination to become involved in "downstream" activities--refining, chemicals, etc. An upswing in 1981 spending for these facilities is in prospect. This includes expansion of marine transport.

Non-communist world capital and exploratory expenditures are less this year than most predictions--up 16% in USA and 11% for total. Including the communist bloc would change the table very little. The communist system is not much better for oil operations than it is for food production. If any sizeable project is attempted it will probably be financed by outsiders.

ESTIMATED CAPITAL AND EXPLORATORY EXPENDITURES FOR FACILITIES AND RESERVES
(U.S. and Non-Communist Countries -- Millions of Dollars -- current Dollars)

	1980			1981^E			1982^E		
	USA	NON-USA	TOTAL	USA	NON-USA	TOTAL	USA	NON-USA	TOTAL
Oil & Gas*	32,400	17,200	$49,600	37,200	16,100	$53,300	37,400	19,500	$56,900
Manufacturing**	5,100	12,860	17,960	5,900	14,260	20,160	6,100	12,180	18,280
Marketing	1,170	2,400	3,570	1,090	2,940	4,030	1,210	3,100	4,310
Liquid Pipelines+	1,100	5,060	6,160	1,370	5,500	6,870	1,670	5,600	7,270
Marine Transport	3,700	6,700	10,400	3,100	7,400	10,500	2,900	7,700	10,600
Other Energies++	4,660	4,040	8,700	5,350	4,810	10,160	6,500	3,600	10,100
Miscellaneous	1,050	1,200	2,250	2,200	2,390	4,590	3,060	3,400	6,460
Sub total	49,180	49,460	$98,640	56,210	53,400	$109,610	58,840	55,080	$113,920
Gas Pipelines‡‡	5,800	4,800	10,600	7,790	5,100	12,890	9,000	5,300	14,300
LNG/SNG+	630	2,220	2,850	400	1,000	1,400	550	1,300	1,850
Sub total	6,430	7,020	$13,450	8,190	6,100	$14,290	9,550	6,600	$16,150
TOTAL	55,610	56,480	$112,090	64,400	59,500	$123,900	68,390	61,680	$130,070

^{E}Estimate. *Includes exploration and development. **Refining and petrochemical investment by oil/gas companies. +Pipeline & Gas Journal estimates. ++Coal, nuclear, shale oil, tar sands, geothermal, etc., expenditures by oil and gas companies. ‡Energy related investment. ‡‡Transmission and distribution capital estimates by Pipeline & Gas Journal. Only change in 1980 is "Oil & Gas" which late in year went up $2 billion.

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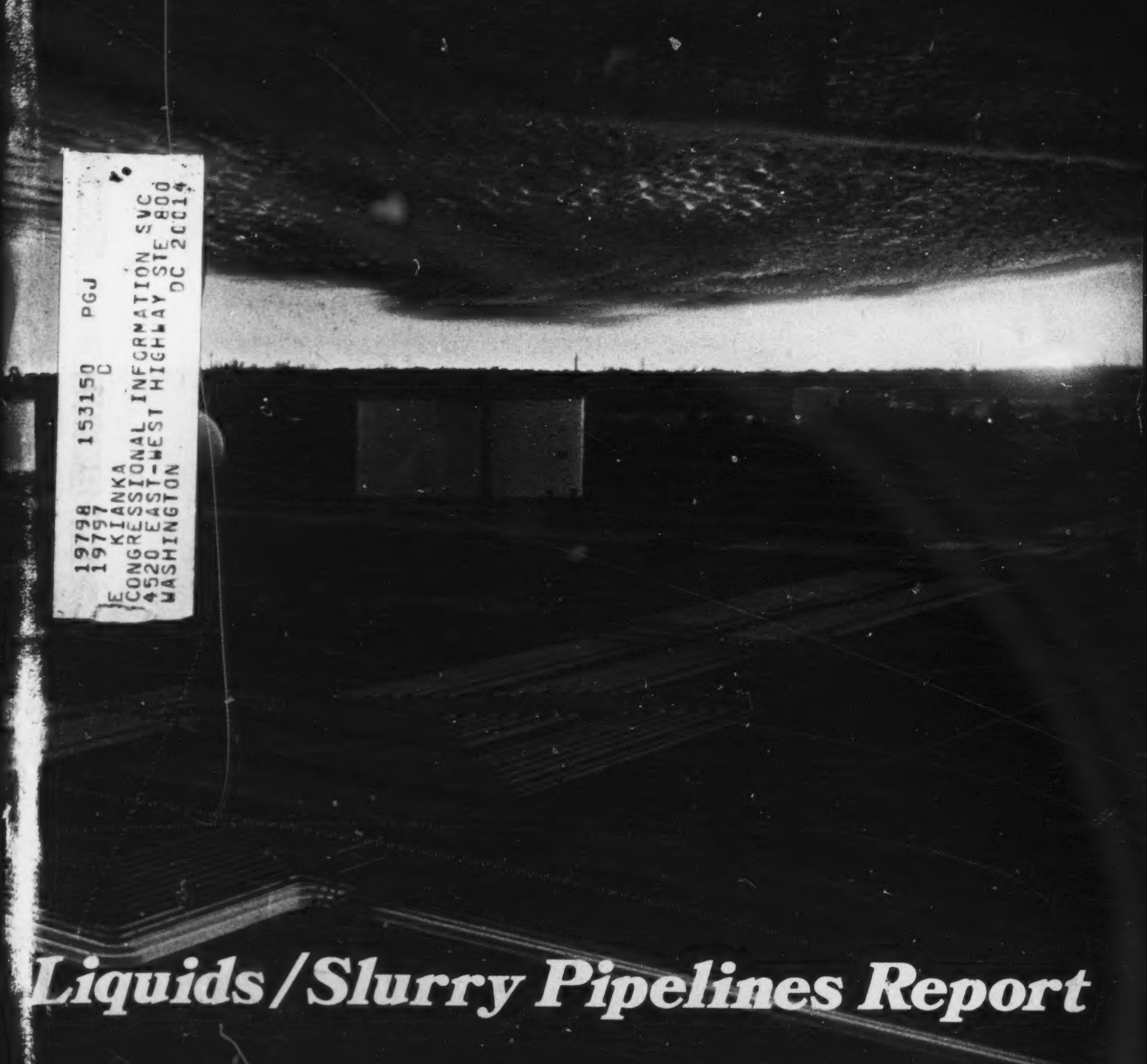

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COVER
This graphic reminder–a sunset view of a major products pipeline terminal–serves as a reminder that the crude oil and products pipelines in the U.S. are the backbone of an energy transportation system that helps insure the economic viability of the U.S.

–photo courtesy Williams Pipe Line Co.

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Pipeline Needs Forecast For 1981-2000 Period 17
Art of forecasting pipeline construction predicts increase in gas lines, decrease in crude, over next 20 years; coal slurry pipelines will account for 25% of all construction during the period.

With Favorable Law Likely, Slurry Line Projects Expanding 21
Favorable political climate at Washington makes prospects look good for coal slurry projects receiving power of *eminent domain.* P&GJ survey shows 11 projects, totaling 10,716 miles, waiting to get off the drawing tables and into the ground.

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E/C/S Firms Have Major Role In Synfuels Development 63
P&GJ's 15th E/C/S Directory lists highly specialized engineering-construction-service firms worldwide with the expertise needed to solve difficult problems.

Forecast: Inter-Regional Pipelines

	1981-1990 Miles	1991-2000 Miles
Gas	11,800	14,200
Crude/Synfuel Oil	5,100	3,800
Coal Slurry	7,700	7,700
Products	2,200	1,000
Carbon Dioxide	2,000	5,000
Total	28,800	31,700
Average Per Year	2,880	3,170

Fig. 1.

Forecast: Energy Demand, Production MMBbl/day

	Coal	Oil	Gas	Shale	Other	Total
1980						
Demand	8	16	9		3	36
Net Exports (Imports)	1	(6)	(1)		—	(6)
U.S. Production	9	10	8		3	30
1990						
Demand	10	14	9		6	39
Net Exports (Imports)	3	(4)	(1)		—	(2)
U.S. Production	13	10	8		6	37
2000						
Demand	16	13	10		8	47
Synfuel Conversion	2	(3)	(1)	2	—	—
Net Exports (Imports)	4	(1)	(1)	—	—	2
U.S. Production	22	9	8	2	8	49

Fig. 2.

Pipeline Needs Forecast For 1981-2000 Period

by **Peter G. Behr,** *Vice President and General Manager, Pipeline and Production Facilities Division,*
and Stephen T. Davenport, *Manager, Pipelines, San Francisco Office,*
Bechtel Petroleum, Inc., Houston, Texas

Forecasting pipeline construction 20 years into the future is an art, not a science. This article does not pretend to give an accurate forecast of the actual pipelines that will be constructed over the next 20 years, but does show an interesting approach to how such a forecast can be prepared.

A summary of our forecast for new "inter-regional" pipeline construction is shown in Fig. 1. Regional pipelines normally represent approximately two times the mileage of inter-regional pipelines, but we have not included a forecast for the regional pipelines. Distribution and field gathering lines are also excluded from the forecast.

It is hoped that readers will not put too much emphasis on the detailed results of our forecast, but instead will consider the trends that may develop, and the effects of energy demand and production on the future needs for new pipelines.

The method used to develop this forecast is based on:

- forecasting the total energy demand for the United States.
- forecasting where the various types of energy such as coal, petroleum, natural gas, and shale will be produced.
- forecasting the new inter-regional pipeline transportation requirements.
- and then forecasting the pipelines required to transport these products to the demand centers.

Time restrictions prevented us from forecasting the Canadian energy demand and production picture in the same detail as for the U.S. It was assumed that Canadian demand would increase at approximately the same rate as that predicted for the U.S. Pipeline construction in Canada will be needed both for serving the Canadian domestic market, and for transporting Alaskan and Canadian Arctic gas to the United States.

Our forecasts for energy demand and production rely heavily on forecasts published by others. Where we found conflicting forecasts, or no solid data was available, we developed our own projections.

The resulting forecasts reflect a strong growth in coal production to serve both domestic consumption and the rapidly growing coal export market. The forecasts also reflect a rapidly growing synthetic fuel industry, and successful prospecting for oil and gas in the Mountain area and in the Arctic. Oil and gas production in the Gulf region was forecast to decline, as old reserves are depleted faster than they are replaced.

In the event that new reserves continue to be discovered to maintain historic production rates in the Gulf region, then perhaps our forecast of total U.S. oil and gas production is too conservative, and oil imports will decline even faster than predicted.

Energy Forecast

Forecasting energy demand and production is the key element in this long-range pipeline forecast. Fig. 2 shows a summary of our forecast of U.S. energy demand and production expressed in millions of barrels per day of oil equivalent. We find that it is difficult to get a consensus from forecasters who represent different areas of expertise such as nuclear power, solar power, synthetic fuel technology, etc. This is a "pipeliner's" forecast, "subject to change without notice."

Rapidly changing rates of consumption of energy make forecasting particularly difficult at this time. Most published energy demand forecasts made only two years ago for the year

Forecast: Energy Demand, Production, % Change/Yr

	Coal	Oil	Gas	Shale	Nuclear & Other	Elect.	Total
1980-1990							
Household & Commercial	—	(3)	1		—	2	1.0
Industrial	3	(6)	2		—	4	1.5
Transportation	—	—	—		—	—	—
Electric Generation	3	(3)	(4)		7	3	2.9
Total Demand	3	(2)	—		7	3	1.0
Total Production	5	(1)	—		7	3	2.1
1990-2000							
Household & Commercial	3	(4)	1		7	3	1.5
Industrial	3	(4)	1		—	2	1.5
Transportation	—	1	—		—	10	1.0
Electric Generation	3	(7)	(1)		3	2	2.4
Total Demand	3	(1)	1		3	2	1.8
Synfuel Conv.	21	20	22	19			
Total Production	5	—	—		3	2	2.8

Fig. 3.

Forecast: Energy Demand and Production

	Coal MMSTY	Oil MMBD	Gas MMMCFD	Shale MMBD	Nuclear & Other MMBD	Total MMBD
1980						
Demand	722	16	54		3	36
Net Exports (Imports)	86	(6)	(3)		—	(6)
U.S. Production	808	10	51	—	3	30
2000						
Demand	1540	13	62		8	47
Synfuel Conversion	227	(3)	(8)	2	—	—
Net Exports (Imports)	341	(1)	(7)	—	—	2
U.S. Production	2108	9	47	2	8	49

Fig. 4.

2000 have been revised downward by about 30% in recent projections. What was forecast for energy consumption by 1990 has been moved out to the year 2000. The marked conservation of energy since the recent price rises has caught most forecasters by surprise.

Fig. 3 shows the percentage change per year used in preparing this forecast. Factors used in the forecast reflect the following:

- Stabilization in oil and gas demand and production in the United States.
- An increase in coal production at a rate of nearly 5% per year.
- The start of synthetic oil and gas production from coal and shale in the 1980s with a rate of increase of some 20% per year in the 1990s.
- An overall rate of increase of energy demand of 1% per year in the United States during the 1980s, becoming approximately 2% per year in the 1990s.
- An overall increase in energy production in the U.S. by 2% to 3% per year during the same period based on increased production of coal, shale oil, and nuclear power.

Our original forecast was prepared using the units of Quadrillion Btu's, which is the best method of forecasting when comparing your own forecast to those produced by others. But it is not a good basis for thinking about the production of oil, gas, or coal. Using a computer, we converted the forecast into units of equivalent natural gas, oil, and coal. These conversions were made using 5.8 MMBtu per bbl of oil equivalent, 1 MMBtu per Mcf of gas equivalent, and 22 MMBtu per short ton of coal equivalent.

Another interesting unit in which energy forecasts can be presented is in Gallons per Person per Day of Oil Equivalent. Fig. 5 shows our forecast in these units.

Forecast Of Production

U.S. oil production for the year 2000 has been forecast at 8.7 million bbl per day. Fig. 6 shows how this production forecast has been allocated by regions between production from "old" 1980 reserves and "new" 1981-2000 discoveries, extensions, and revisions. This is the most difficult part of the forecasting work, since very little data is available on anticipated oil and gas production by region.

To complete the forecast, it is necessary to make a distribution. We predicted the depletion of "old" reserves, as dictated by the remaining life of the reserves. And we predicted a relatively rapid discovery rate of new reserves in the Mountain region and in the Arctic.

To arrive at total oil production, we added synthetic oil produced from shale and other sources, with the majority of this production being allocated to the

Forecast: Gas Production, Bcf/Day

	Gulf	Alaska	Mountain	Other	Total
1980					
U.S. Production	36	1	5	9	51
Imports					3
Total Demand					54
2000					
Production From "Old" Reserves	6	3	1	1	11
Production From "New" Discoveries, Extensions & Revisions	17	2	9	8	36
	23	5	10	9	47
Synthetic Gas			2	6	8
Imports					7
Total Demand			12	15	62

Fig. 7.

Forecast: Coal Production, MMTons/Yr

	Transport Method				
	Rail or Local	Slurry Pipeline	Synfuel Oil Pipeline	Synfuel Gas Pipeline	Total
1980	803	5	—	—	808
2000					
Eastern Region	985	93	33	50	1161
Mountain Region	451	190	50	75	766
Synfuel Loss	181	—	—	—	181
Total	1617	283	83	125	2108

Fig. 8.

Forecast: Energy Demand, Gal/Person/Day Oil Equiv.

	Coal	Oil	Gas	Nuclear & Other	Elect.	Total
1980 (220 Million People)						
Household & Commercial	—	0.6	0.7		1.3	2.6
Industrial	0.3	0.6	0.7		0.9	2.5
Transportation	—	1.6	0.1		—	1.7
Electric Generation	1.1	0.3	0.3	0.5	(2.2)	—
Total Demand	1.4	3.0	1.8	0.5	—	6.8
2000 (240 Million People)						
Household & Commercial	—	0.3	0.8	0.1	1.9	3.1
Industrial	0.6	0.2	0.9	—	1.5	3.2
Transportation	—	1.6	0.1	—	—	1.7
Electric Generation	1.9	0.1	0.1	1.3	(3.4)	—
Total Demand	2.5	2.2	1.9	1.4	—	8.0

Fig. 5.

Forecast: Oil Production, MMBbl/Day

1980	Gulf	Alaska	Mountain	Other Oil	Gas Liquids	Total
U.S. Production	4.2	1.6	0.8	2.1	1.3	10.0
Imports						6.0
Total Demand						16.0
2000						
Production From "Old" Reserves	0.6	0.5	0.1	0.3	0.5	2.0
Production From "New" Discoveries, Extensions & Revisions	1.3	1.5	1.3	1.7	0.9	6.7
	1.9	2.0	1.4	2.0	1.4	8.7
Synthetic Oil	—	—	2.5	0.3	—	2.8
Imports	—	—	—	—	—	0.7
Total Demand			3.9	2.3		12.2

Fig. 6.

Mountain region.

Fig. 7 shows the same allocation for natural and synthetic gas production. Again, our allocation shows a drop in production in the Gulf region, and a rapid build-up of production in the Mountain region and Alaska.

Fig. 8 shows the same type of allocation for coal production between "Eastern" and "Mountain" regions. This figure also shows the delivery of coal to market by rail, slurry pipeline, or by oil or gas pipeline as synthetic fuels. If our forecast of production is right, there should be plenty of business for both the railroads and the pipeline industry in the next 20 years.

Forecast Of New Pipelines

The last step in the forecast was to predict the pipeline construction requirements for the period 1981-2000. To do this, we reviewed the data developed previously on energy demand and production, and derived the requirements for new throughput capability. Figure 9 shows the summary of inter-regional pipeline transportation requirements that was developed.

For the actual forecast of pipeline construction, we developed a computer program capable of listing individual pipelines and calculating summaries of their length, cost, throughput, and weighted average diameter. We listed all the plans for pipelines found in the press, and then discounted them by a percentage to reflect the fact that not all pipelines planned get built. The total throughput volume of the planned pipelines was then compared to the throughput requirements found from the energy forecast. For regions where additional pipeline capacity was needed, new "unidentified" pipelines were added to make up the total throughput volume needed for the region.

Summary And Conclusions

Based on the assumptions, and using the forecasting method described in this paper, we have reached the following conclusions regarding the future of pipeline construction activity for transmission pipelines in the U.S. and Canada over the next 20 years:

- ✓ Gas pipeline activity will be highlighted by new pipelines from the Alaskan and Canadian Arctic, and new gas pipelines from the Mountain region will be built to serve synthetic gas conversion plants and new natural gas discoveries (Fig. 11).
- ✓ Crude oil pipeline activity will decline as the consumption of oil in the United States stabilizes. New lines will be built to serve the Canadian Arctic and the synthetic oil plants in the Mountain region (Fig. 12).
- ✓ Products pipeline activity will also decrease as the consumption of petroleum products stabilizes.

Forecast: New Inter-Regional Pipeline Requirements

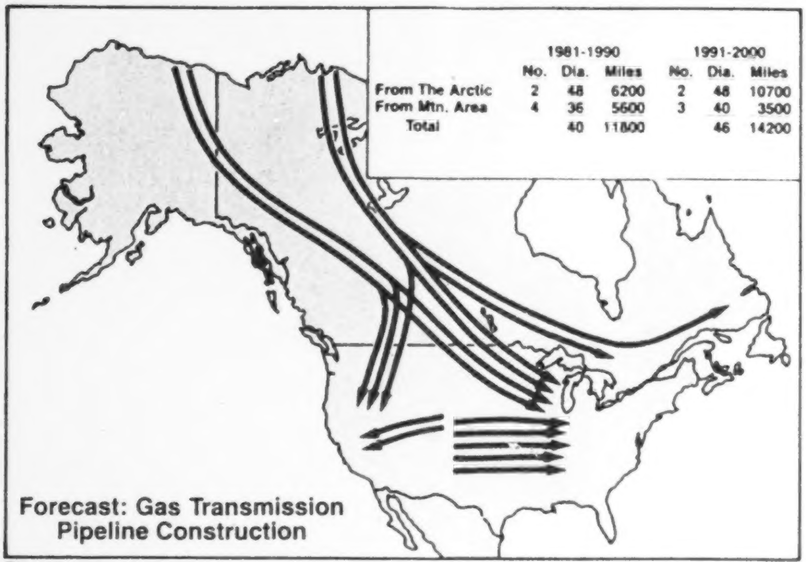
	1981-2000
Gas (MMcfd)	
From Alaska	4000 MMcfd
From Mountain Area	7000 MMcfd
From Canadian Arctic	4000 MMcfd
Oil (MMbd)	
From Mountain Area	3100 Mbd
From Canadian Arctic	300 Mbd
Coal Slurry (MMsty)	
From Mountain Area	190 MMsty
From Eastern Area	93 MMsty

Fig. 9.

Forecast: Energy Imports, Exports, BBl/Day Oil Equiv.

1980	
Demand	36,000,000
Production	30,000,000
Net Imports	6,000,000
2000	
Production	49,000,000
Demand	47,000,000
Net Exports	2,000,000

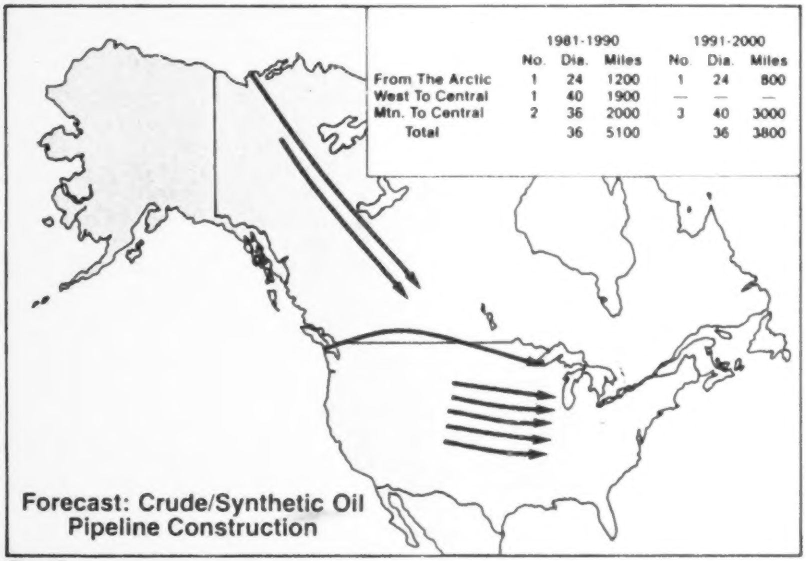
Fig. 10.



Forecast: Gas Transmission Pipeline Construction

	1981-1990			1991-2000		
	No.	Dia.	Miles	No.	Dia.	Miles
From The Arctic	2	48	6200	2	48	10700
From Mtn. Area	4	36	5600	3	40	3500
Total		40	11800		46	14200

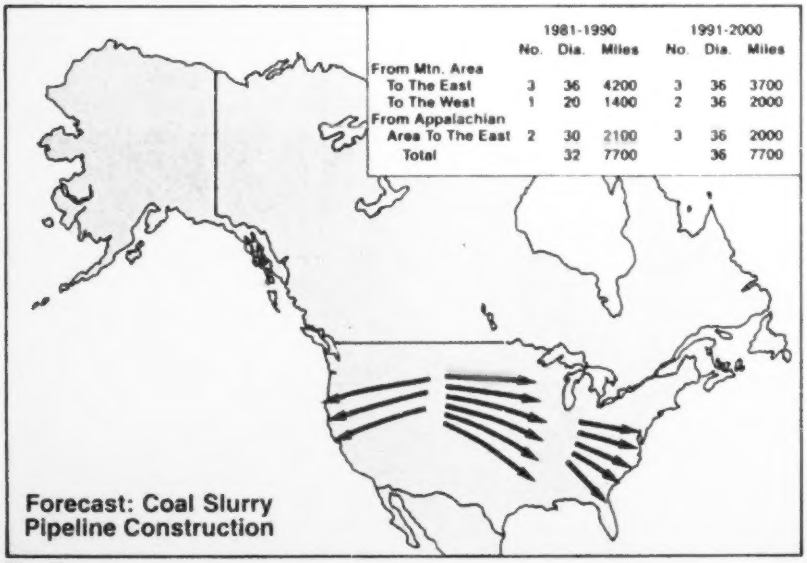
Fig. 11.



Forecast: Crude/Synthetic Oil Pipeline Construction

	1981-1990			1991-2000		
	No.	Dia.	Miles	No.	Dia.	Miles
From The Arctic	1	24	1200	1	24	800
West To Central	1	40	1900	—	—	—
Mtn. To Central	2	36	2000	3	40	3000
Total		36	5100		36	3800

Fig. 12.



Forecast: Coal Slurry Pipeline Construction

	1981-1990			1991-2000		
	No.	Dia.	Miles	No.	Dia.	Miles
From Mtn. Area						
To The East	3	36	4200	3	36	3700
To The West	1	20	1400	2	36	2000
From Appalachian Area To The East	2	30	2100	3	36	2000
Total		32	7700		36	7700

Fig. 13.

- ✓ Coal slurry pipeline construction will be a bright spot in the future of U.S. pipeline construction, making up 25% of the inter-regional pipeline construction. These pipelines will serve both U.S. electric generation plants and the rapidly expanding export market for coal. Even with the projected pipeline construction, railroads will be rapidly increasing their coal hauling activities (Fig. 13).
- ✓ Pipelines carrying carbon dioxide from underground reservoirs and from synthetic fuel plants to old oil fields for enhanced recovery purposes will add to the total pipeline picture.
- ✓ And remember if our projections prove to be correct, the U.S. will be a net exporter of energy by the year 2000 (Figure 13). That is a worthwhile goal for the energy industry.

P&GJ

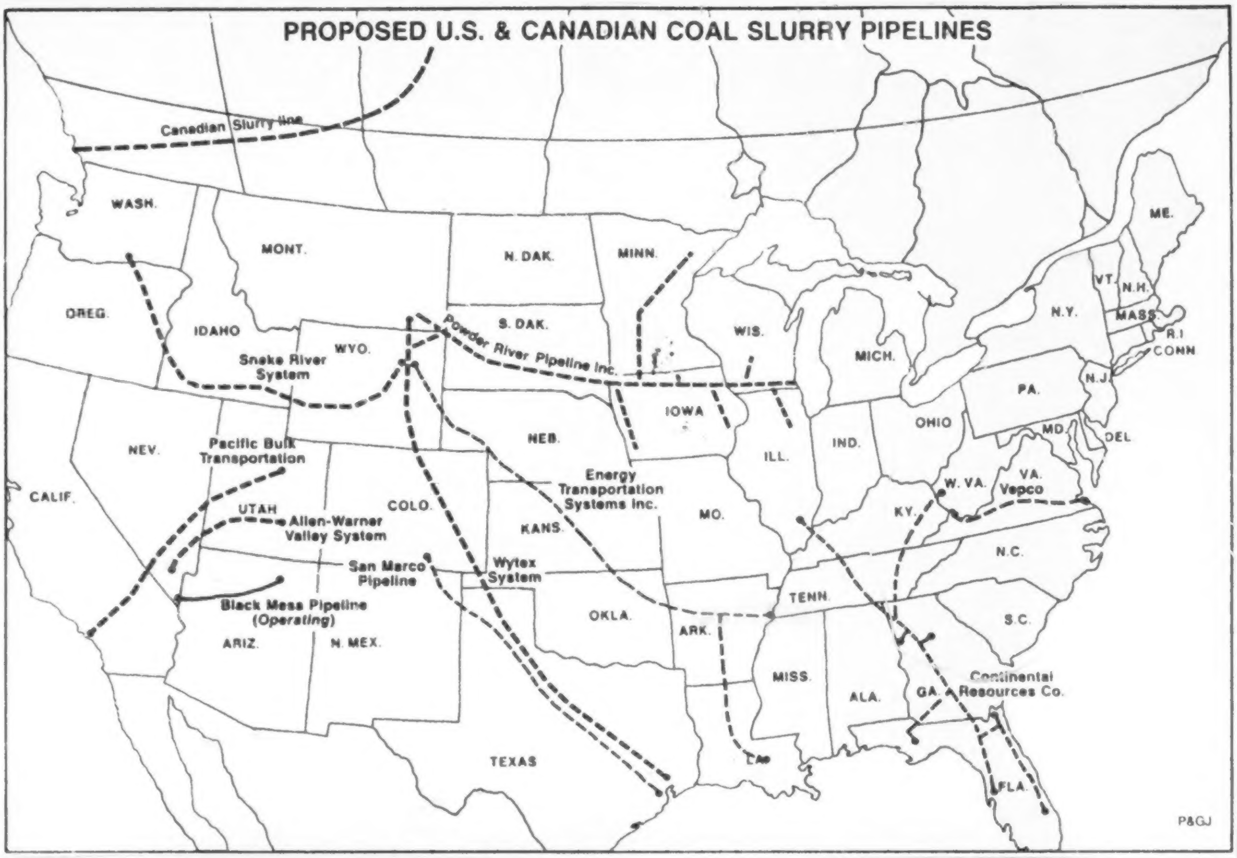
About The Authors

Behr

Davenport

***Peter G. Behr** is vice president of Bechtel Petroleum Inc. and general manager of its Pipeline and Production Facilities Division in Houston. During his 25 years with Bechtel, Behr has had broad engineering, construction, and management experience in the U.S. and overseas. He joined Bechtel's Pipeline Division in 1955 as an engineer, subsequently worked on the Trans-Arabian Pipeline, in North Africa, and in the Paris office. In 1967 he was named manager of European, North African, and Middle East operations. He is a native of Fresno, Calif., and holds a B.S. degree in mechanical engineering from Stanford University. He is a licensed professional engineer and a member of ASME.*

***Stephen T. Davenport** has more than 30 years experience as an engineer in the pipeline business. A graduate of MIT with a degree in mechanical engineering, he worked with Aramco, Trans-Arabian Pipeline, and Standard Oil of California before joining Bechtel's Pipeline Division. He has participated in the engineering and construction of major pipelines in Europe and, since returning to the U.S., has managed the economics group, engineering department, and business development department of Bechtel's Pipeline Division. He is presently an executive engineer in Bechtel Petroleum Inc.*


PROPOSED U.S. & CANADIAN COAL SLURRY PIPELINES
Canadian Slurry line
WASH.
OREG.
IDAHO
MONT.
WYO.
Snake River System
NEV.
CALIF.
Pacific Bulk Transportation
UTAH
Allen-Warner Valley System
COLO.
San Marco Pipeline
Black Mesa Pipeline (Operating)
ARIZ.
N. MEX.
N. DAK.
S. DAK.
MINN.
Powder River Pipeline Inc.
NEB.
KANS.
Energy Transportation Systems Inc.
Wytex System
OKLA.
TEXAS
IOWA
WIS.
MO.
ILL.
ARK.
LA.
MISS.
TENN.
ALA.
GA.
FLA.
Continental Resources Co.
MICH.
IND.
OHIO
KY.
W. VA.
VA.
Vepco
N.C.
S.C.
PA.
N.Y.
ME.
VT.
N.H.
MASS.
R.I.
CONN.
N.J.
MD.
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With Favorable Law Likely, Slurry Line Projects Expanding

by Dean Hale, *Editor*

Interest in coal slurry pipelines continues to mount and supporters of coal slurry pipeline projects are looking optimistically at Washington and new efforts to obtain Congressional approval on a bill that would give coal slurry lines the same right of *eminent domain* as that granted to natural gas pipelines.

A bill providing that right is being introduced by the Public Works and Transportation Committee in the House of Representatives, headed by committee chairman James J. Howard (D-N.J.). Terms of the bill, under formulation for some time, would include very protective language to protect the water rights of the various states; legal rights to water and access to water would not be a part of the legislation.

The new bill is not just a "western states" bill, emphasizes a spokesman for the Slurry Transportation Association, the industry's legislative watchdog in the nation's capitol. Considerable interest has been generated on the East Coast in favor of slurry pipelines, which are considered to have great potential for moving coal from mines to coastal terminals, permitting the U.S. coal industry to more effectively participate in the export coal market.

In addition to the export market, there are opportunities to transport coal competitively to the southeastern states and to provide greater access to coal from Appalachia. Even southern Illinois coal producers have become interested – slurry lines would open new markets for the high sulfur coal mined in that area, and which mostly moves by barge down the Mississippi River.

Railroad arguments against coal slurry pipelines getting the right of *eminent domain* are not as strong now that railroads have been deregulated, STA spokesmen say. That deregulation plus some big mergers – such as the recent CSX merger (C&O-B&O with the "Family Lines" of SCL, L&N, etc.) and the forthcoming Southern Railway-Norfolk & Western Railway – has eliminated much of the rail competition in the southeastern U.S. Without competition, there is little effective price moderation available on transportation costs.

With growing support from all areas of the nation, increased emphasis on coal production and utilization (and export), greater public awareness of the need for competition in the transportation area, and an improved economic and political climate, concrete results are expected in the legislative area this year, says STA.

It can't be too soon. The current project scorecard for coal slurry pipelines shows 10 projects in the U.S. plus one proposed in Canada. These planned, proposed, and under study lines total 10,716 miles. The accompanying table gives details.

Energy Transportation System, Inc. continues to forge ahead with its plans to get construction underway in 1983 and to have the line completed by 1985, at which time it will begin transporting some 37 million tons of coal per year from Wyoming to points in Oklahoma, Arkansas, and Louisiana.

ETSI has set up field offices in Kansas, Nebraska, and Wyoming to purchase right-of-way options. Similar operations will begin soon in the other states traversed by the pipeline.

Bechtel Petroleum, Inc. of Houston

U.S. & Canadian Coal Slurry Pipelines

Company	Miles	Sizes (In.)	From	To	Estimated Cost ($Millions)	Status	Contractor or Engineering Co.	Annual Tonnage
Alberta Economic Development, Energy & Natural Resources Ministries	500	Unk.	Hinton, Alberta	West Coast Port	–	Planned	Fluor (E)	N.A.
Allen-Warner Valley Energy Systems (Nevada Power Co.)	253	20,24	Alton, Utah	Las Vegas Nev.	$270	Planned	–	11.6 mm
Coalstream Pipeline Co. (Continental Resources Inc.)	1500	24-48	Kentucky	Florida	$3000	Planned	Fluor (E)	55 mm
Energy Transportation Systems Inc.	1400	38	Wyoming	Baton Rouge La.	$2000	Planned	Bechtel (E)	37 mm
Pacific Bulk Transportation Systems (Boeing Engineering & Construction Co.)	650		Emory, Carbon counties, Utah	Port Hueneme, Calif.	$500	Planned	Boeing (E)	10 mm
Powder River Pipeline Inc.	1923	42	S.E. Montana	Great Lakes areas, other terminals	$1260	Planned	–	36 mm
San Marco Pipeline Co. (Houston Natural Gas, Rio Grande Industries)	900	20, 24	S.E. Colorado	Texas Gulf Coast	$800	Planned	–	15 mm
Snake River System (N.W. Energy, Gulf Interstate)	1100	20, 24	N.E. Wyoming	Idaho, Oregon	$500	Planned	–	10 mm
Tesoro Petroleum Corp.	1000	30	Kentucky	Southeastern U.S.	$1000	Planned	–	N.A.
Virginia Electric Power Co.	300	12-36	Proud, W.V.	Portsmouth, Va.	$250	Planned	–	10 mm
Wytex System (Texas Eastern, Brown & Root)	1260	36,40	Powder River basin, Wyo.	Houston area	$1800	Planned	Brown & Root (E)	22 mm

has been named by ETSI to carry out Phase Two (the definitive phase) of the 1400-mile project. This phase, representing a commitment of some $70 million, includes completion of the right-of-way acquisition, design and engineering work, and a coal evaluation program. The project ultimately is expected to cost more than $2 billion – largest ever undertaken in the Lower 48.

Under construction at Arkansas Power & Light Co.'s White Bluff generating station is a demonstration plant to evaluate the materials and processes that ETSI expects to use in building the line. The White Bluff plant will test major components, including front-end processes for coal slurry preparation and tail-end processes for dewatering, drying, coal handling and storage, as well as a test loop to evaluate pipeline and pumping equipment.

The plant will include a water treatment facility to demonstrate that the pipeline's wastewater can be treated to produce water acceptable for discharge or reuse according to local water quality standards.

Participation in the ETSI project expanded early in 1981 as Texas Eastern Corp.'s subsidiary, Texas Eastern Slurry Transport Co. joined the other four partner companies (Atlantic Richfield, Bechtel, Lehman Brothers Kuhn Loeb, and Kansas-Nebraska Natural Gas) in ownership; Texas Eastern acquired the 20% interest formerly held by United Energy Resources. Texas Eastern indicated that it intended to continue to examine other slurry pipeline projects.

Powder River Pipeline Inc., a new Montana firm, has announced plans for a 1923-mile, $1.26 billion coal slurry pipeline project to serve the upper Midwest and provide markets for coal from southeastern Montana. PRPI's 42-in. line would transport coal from mines in the Powder River basin in Montana and Wyoming for power generating plants in Minnesota, Wisconsin, Illinois, and Iowa.

As initially proposed, the main slurry pipeline would be laid along an abandoned railroad right-of-way. The line would terminate in Milwaukee and have branches to Duluth, in western Iowa, and in southern Wisconsin and north central Illinois. An alternative proposal would involve delivering coal to a port on the west side of Lake Michigan for barge transport of coal to Michigan utilities.

Coalstream Pipeline Co. has been formed as a new subsidiary of Continental Resources Co. to build and operate a proposed coal slurry line connecting eastern coal fields with markets in Georgia and Florida. The 1500-mile line would be designed to transport up to 55 million tons per year from Illinois and Appalachian fields. Also under consideration is a coal exporting facility somewhere along the Southeast Atlantic coast that could deliver 10 million tons of coal annually for export to foreign markets.

Coalstream's system, involving lines ranging from 16 to 36-in. diameter, would cost approximately $3 billion by the time it was completed.

Alberta Ministries of Economic Development, Energy, and Natural Resources have awarded a contract to a consortium that includes Fluor Canada Ltd., Fluor Ocean Services, Inc., Houston, and Pipeline Systems, Inc., San Francisco, to study the feasibility of transporting Alberta coal over 500 miles by slurry pipeline from Hinton, Alberta (about 50 miles northeast of Jasper) to a West Coast Canadian port facility (probably near Vancouver). Thermal coal to be transported most likely would be exported. Alberta government officials said that consideration of a coal slurry pipeline was brought about by high transportation costs by rail that have inhibited expanding opportunities to market thermal coal.

Other major projects (see table) continue to be studied and developed as prudently as possible.

Major impediments, in most cases, are acquisition of rights to water sources, acquisition of rights-of-way (federal legislation will help eliminate this problem), preparation of environmental impact statements, and attracting financing.

Engineering techniques for the design and construction of slurry pipelines have been developed and proven. Technology is not a question today.

Proponents of slurry pipelines are confident that – as the need for competitive coal transportation grows – slurry pipelines will become abundant and prove a major economics force. They will also contribute heavily to the changing energy flow patterns predicted for the 1980s and 1990s. **P&GJ**

"Big Oil" Takes it on the Chin

by Greg Martin, *Editor, ENERGY NEWS/ENERGY WEEK*

First quarter earnings of 62 oil companies plunged 13.6% from first quarter of 1980, dragged down by heavy losses in the refining sector of integrated companies. Income continued to rise for independent producers, boosted by the final increment of U.S. crude oil decontrol on Jan. 28. The profit margin for the entire group fell from 6.9% to 5.2%.

"Big Oil" took it on the chin as refiners were forced to cut prices to try to get rid of bulging product inventories. In the weakening market for gasoline, refiners couldn't raise prices enough to recoup rising costs of crude oil.

Some refiners found themselves buying OPEC crude for $4/bbl more than the selling price of refined product yields. Those without oil/gas production, like Ashland, Clark Oil and Tosco, suffered most.

Income declines, of course, were relative to record earnings in first quarter 1980. Majors like Standard Indiana, Gulf and Conoco saw big refining/marketing profits in that quarter turn to big losses in 1981's first quarter.

Texaco shook a 10% earnings gain out of inventories. It needs less product to supply its customers after closing part of its retail markets. Standard Ohio's gain was due to higher prices for Alaskan crude oil; Standard California credited higher prices for crude and natural gas.

"A free market does not quickly absorb sudden cost increases when demand is weak," said Robert Anderson, chairman, Atlantic Richfield. W. C. Douce, head of Phillips, noted: "The recent decline in the price of gasoline is evidence of the vigorous competition that is taking place."

Majors also had to pay sharply higher "windfall profits" tax (WPT) compared to first quarter 1980, when the tax was in effect only one

(Continued on page 8)

FIRST QUARTER GAS COMPANIES FINANCIAL REPORTS

	Three months ending March 31**						Profit Margin‡	
	Revenues ($000)			Earnings* ($000)				
	1981	1980	% Chg.	1981	1980	% Chg.	1981	1980
Alabama Tennessee N.G.	34,064	26,778	+ 27.2	1,638	1,324	+ 23.7	4.8	4.9
American Nat. Resources	1,124,220	976,333	+ 15.1	61,254	54,160	+ 13.1	5.4	5.5
Arkansas Louisiana Gas	339,659	286,312	+ 18.6	34,432	35,898	- 4.1	10.1	12.5
Columbia Gas	1,439,821	1,302,382	+ 10.6	83,394	82,478	+ 1.1	5.8	6.3
Commonwealth Nat. Res.	76,846	70,207	+ 9.5	2,975	3,124	- 4.8	3.9	4.4
Consolidated Nat. Gas	1,043,042	953,206	+ 9.4	71,218	70,003	+ 1.7	6.8	7.3
ENSERCH Corp.	834,842	694,687	+ 20.2	58,354	45,290	+ 28.8	7.0	6.5
Equitable Gas	160,327	125,326	+ 27.9	20,660	16,680	+ 23.9	12.9	13.3
Houston N.G.[1]	719,477	586,632	+ 22.7	61,807	49,295	+ 25.4	8.6	8.4
InterNorth	1,142,615	938,396	+ 21.8	116,957	111,114	+ 5.3	10.2	11.8
Mountain Fuel Supply	146,557	129,025	+ 13.6	14,575	14,950	- 2.5	9.9	11.6
ONEOK Inc.	333,877	280,206	+ 19.2	21,239	20,929	+ 1.5	6.4	7.5
Peoples Energy	1,234,686	1,075,862	+ 14.8	88,770	66,242	+ 34.0	7.2	6.2
Pioneer Corp.	288,155	210,483	+ 36.9	29,198	23,430	+ 24.6	10.1	11.1
Southern Nat. Resources	678,054	553,782	+ 22.4	47,348	37,050	+ 27.8	7.0	6.7
Texas Eastern Corp.	1,154,547	1,086,711	+ 6.2	62,608	61,258	+ 2.2	5.4	5.6
Texas Gas Transmission	683,164	585,333	+ 16.7	31,628	25,073	+ 26.1	4.6	4.3
TransCanada PipeLines	961,533	782,892	+ 22.8	25,955	22,050	+ 17.7	2.7	2.8
Transco Companies	865,190	586,235	+ 47.6	31,386	28,357	+ 10.7	3.6	4.8
Union Gas Ltd.	315,794	260,352	+ 21.3	16,532	15,485	+ 6.8	5.2	5.9
United Energy Resources	1,264,076	1,034,782	+ 22.2	55,404	41,702	+ 32.9	4.4	4.0
Westcoast Transmission	371,903	436,986	- 14.9	15,927	11,920	+ 33.6	4.3	2.7
TOTAL	15,212,449	12,982,098	+ 17.2	953,259	837,812	+ 13.8	6.3	6.5

*Earnings available to common. **Excluding non-recurring items. ‡Earnings* divided by Revenues.

[1] Three months ending January 31.

FIRST QUARTER OIL COMPANIES FINANCIAL REPORTS

		Three months ending March 31**							
		Revenues ($000)			Earnings* ($000)			Profit Margin‡	
		1981	1980	% Chg.	1981	1980	% Chg.	1981	1980
1.	Adobe Oil	39,305	39,221	+ 0.2	5,156	5,068	+ 1.7	13.1	12.9
2.	Alaska Interstate	91,278	56,735	+ 60.9	17,946	14,221	+ 26.2	19.7	25.1
3.	Amerada Hess	2,969,215	2,325,398	+ 27.7	174,536	198,978	- 12.3	5.9	8.6
4.	American Petrofina	666,473	523,374	+ 27.3	20,250	31,410	- 35.5	3.0	6.0
5.	American Quasar	13,716	10,085	+ 36.0	650	2,242	- 71.0	4.7	22.2
6.	Arapaho Petroleum[1]	14,401	5,517	+161.0	112	142	- 21.1	2.6	4.5
7.	Argo Petroleum	4,160	3,229	+ 28.8	645	474	+ 36.1	15.5	14.7
8.	Ashland Oil	2,153,998	2,040,159	+ 5.6	715	42,262	- 98.3	0.03	2.1
9.	Atlantic Richfield	7,132,320	5,461,176	+ 30.6	346,484	427,017	- 18.9	4.9	7.8
10.	Belco Petroleum	232,684	211,543	+ 10.0	26,246	18,243	+ 43.9	11.3	8.6
11.	Buttes Gas & Oil	37,630	40,217	- 6.4	2,943	3,186	- 7.6	7.8	7.9
12.	Callon Petroleum[1]	2,123	1,578	+ 34.5	238	384	- 38.0	11.2	24.3
13.	Clark Oil & Refining	403,708	402,274	+ 7.1	(4,469)	14,100			3.5
14.	Commonwealth Oil Ref.	304,569	306,243	- 0.5	(22,348)	(6,700)			
15.	Consolidated O&G	11,537	8,141	+ 29.4	1,982	94	+2008.5	17.2	1.2
16.	Conoco	5,396,200	4,300,000	+ 24.6	250,900	328,600	- 23.6	4.6	7.6
17.	Crown Central Petr.	379,080	306,230	+ 23.8	(10,228)	11,478			3.7
18.	Crystal Oil	75,874	58,321	+ 30.1	(1,573)	2,887			5.0
19.	Delhi Int'l Oil	7,919	5,596	+ 41.5	1,181	981	+ 20.4	14.9	17.5
20.	Diamond Shamrock	864,968	755,331	+ 14.5	48,037	56,255	- 14.6	5.6	7.4
21.	Discovery Oil	1,379	446	+209.2	102	(14)		7.4	
22.	Dorchester Gas[1]	151,874	174,778	- 13.1	6,631	7,583	- 12.6	4.4	4.3
23.	Dyco Petroleum	10,579	6,396	+ 65.4	2,956	1,610	+ 83.6	27.9	25.2
24.	Exxon	30,323,000	27,654,000	+ 9.7	1,600,000	1,925,000	- 16.9	5.3	7.0
25.	Felmont	19,047	11,948	+ 59.4	4,952	3,749	+ 32.1	26.0	31.4
26.	Forest	31,094	21,464	+ 44.9	2,282	2,123	+ 7.5	7.0	10.0
27.	Getty Oil	3,294,621	2,268,699	+ 45.2	229,930	225,548	+ 1.9	7.0	9.9
28.	Gulf Oil Corp.	7,874,000	7,753,000	+ 1.6	303,000	389,000	- 22.1	3.8	5.0
29.	Howell Petroleum	22,179	4,381	+406.3	1,924	862	+123.2	8.7	19.7
30.	Inexco Oil	52,898	31,720	+ 66.8	6,345	5,747	+ 10.4	12.0	18.1
31.	Kerr-McGee Corp.	916,126	780,394	+ 17.4	43,337	47,142	- 8.1	4.7	6.0
32.	Louisiana L&E	322,802	264,954	+ 21.8	50,562	51,593	- 2.0	15.7	19.5
33.	Mapco Inc.	580,021	378,811	+ 53.1	25,435	31,296	- 18.7	4.4	8.3
34.	Marathon Oil	2,424,098	2,265,368	+ 7.0	69,775	139,071	- 49.8	2.9	6.1
35.	McFarland Energy	3,985	3,389	+ 17.6	1,175	1,065	+ 10.3	29.5	31.4
36.	Mesa Petroleum	103,624	106,930	- 3.1	29,841	19,913	+ 49.9	28.8	18.6
37.	Mobil Corp.	17,095,000	15,278,000	+ 11.9	640,000	846,000	- 24.3	3.7	5.5
38.	Murphy Oil	666,806	569,245	+ 17.1	38,430	28,390	+ 35.4	5.8	5.0
39.	Natomas	369,348	294,214	+ 25.5	58,237	48,015	+ 21.3	15.8	16.3
40.	Noble Affiliates	87,503	67,584	+ 29.5	10,850	13,459	+ 34.1	20.6	19.9
41.	Occidental Petroleum	3,379,600	3,346,600	+ 10.0	259,400	277,900	- 6.7	7.7	8.3
42.	Pacific Resources	231,382	206,960	+ 11.8	(1,380)	9,030			4.4
43.	Patrick Petroleum[2]	18,634	12,376	+ 50.6	1,304	574	+127.2	7.0	4.6
44.	Pennzoil Co.	687,988	612,905	+ 12.3	59,123	82,501	- 28.3	8.6	13.5
45.	Phillips Petroleum	4,228,469	3,384,162	+ 24.9	270,784	284,414	- 4.8	6.4	8.4
46.	Quaker State	218,157	194,860	+ 12.0	3,636	6,879	- 47.1	1.7	3.5
47.	Shell Oil	5,413,000	4,798,000	+ 12.8	361,000	373,000	- 3.2	6.7	7.8
48.	Southland Royalty	95,680	90,635	+ 5.6	10,248	18,800	- 45.5	10.7	20.7
49.	Standard California	11,988,000	10,447,000	+ 14.8	660,000	627,000	+ 5.3	5.5	6.0
50.	Standard Indiana	7,853,100	6,450,900	+ 21.7	376,700	576,000	- 34.6	4.8	8.9
51.	Standard Ohio	3,119,300	2,658,700	+ 17.3	520,400	450,700	+ 15.5	16.7	17.0
52.	Statex Petroleum	2,504	1,243	+101.4	589	186	+216.7	23.5	15.0
53.	Sun Co.	4,000,000	3,100,000	+ 29.0	120,000	251,000	- 52.2	3.0	8.1
54.	Superior Oil	492,906	330,287	+ 49.2	107,960	90,566	+ 19.2	21.9	27.4
55.	Tenneco	3,809,000	3,316,000	+ 14.9	194,000	178,000	+ 9.0	5.1	5.4
56.	Tesoro	841,574	823,265	+ 2.2	23,273	36,155	- 35.6	2.8	4.4
57.	Texaco Inc.	15,453,000	13,248,900	+ 16.6	658,000	600,600	+ 9.6	4.3	4.5
58.	Texas Oil & Gas	389,659	294,901	+ 32.1	47,874	34,783	+ 37.6	12.3	11.8
59.	Tosco Corp.	762,429	534,162	+ 42.7	(38,688)	22,629			4.2
60.	Tribune Oil	563	472	+ 19.3	164	191	- 14.1	29.1	40.5
61.	Union California	2,666,458	2,375,612	+ 12.2	154,479	152,922	+ 1.0	5.8	6.4
62.	Woods Petroleum	16,377	11,968	+ 36.8	4,667	3,065	+ 52.3	28.5	25.6
	TOTAL	150,818,922	131,035,997	+ 15.1	7,785,900	9,015,369	- 13.6	5.2	6.9

*Earnings available to common. **Excluding non-recurring items. () Loss. ‡Earnings* divided by revenues. [1]Ends February 28, 1981 and February 29, 1980. [2]Third quarter ends January 31, 1981.

month. Standard California said its $377 million WPT payments were higher than for all of 1980.

Other WPT totals: Exxon, $584 million; Standard Indiana, $532.4 million; Atlantic Richfield, $449 million; Shell, $387 million; Gulf, $327 million; Texaco, $319.2 million; Mobil, $249 million; Union California, $139.5 million.

In times of controlled prices, the lost margins of profit could be "banked" for later recovery. Now, refiners must find a way out.

Nonetheless, refiners' outlook for the rest of 1981 is not that bleak. Standard Indiana, Union California and Conoco still expect improvement over 1980, as refiners absorb major capital expenditures for refinery modifications and the full impact of oil price decontrol.

Clark Oil says consumer resistance to higher product prices is putting pressure on crude oil producers to lower prices. "We expect some degree of price improvement for the balance of 1981, and further margin improvements will be realized." Tosco expects "further strengthening over the rest of the year." Pacific Resources anticipates "a strong second half as product prices and markets strengthen."

Independent producers will show big earnings gains this year—but they'll also be saddled with big WPT payments.

Gas company results were mixed. Net income for the group as a whole rose 13.8% over first quarter 1980, but revenue gains outstripped earnings as rising costs of natural gas were passed through to end users. The group's profit margin dipped from 6.5% to 6.3%.

As in 1980, gas companies derived an increasing share of earnings from nonregulated operations — oil/gas exploration and production, gas processing, contract drilling.

Exploration/production earnings for InterNorth rose 167% over previous year's first quarter. Tax credits from InterNorth's investment in Northern Border Pipeline project also helped.

Impetus behind ENSERCH's record first quarter earnings came from exploration/production and oilfield services segments, as gas transmission and distribution income fell. Nonutility business also was the main factor in ONEOK's increased earnings.

Contract drilling operations were largely responsible for Peoples Energy Corp.'s income gain, offset by weak industrial gas markets and higher operating and financing costs.

Columbia Gas benefited from "increased sales of oil, gas, propane and other hydrocarbons." Income would have been greater except for reduced industrial gas sales and loss of equity earnings on the LNG facility at Cove Point, MD.

Mountain Fuel Supply's utility operations had lower income, but oil/gas earnings were sharply higher due to decontrol.

All segments of Southern Natural Resources showed big earnings gains: Gas pipeline operations up 25%, exploration/production up 71%, contract drilling up 121%.

All units of United Energy Resources contributed to record first quarter earnings. United's pipeline system had its lowest level of gas curtailments in recent history. ■

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ENERGY CONSTRUCTION, TRANSPORTATION & DISTRIBUTION

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Construction Innovations

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PIPELINE & GAS JOURNAL

International Pipeline & Gas Utility Design, Construction & Operation

Published Continuously Since 1859

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COVER
Pipeline construction on the move is typified by this view of crews at work on the Phillips Pipe Line Co.'s 420-mile Borger, Tex., to Paola, Kan., products line.

—Photo courtesy Phillips Petroleum Co.

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Pipeliners have risen to unique challenges with new and improved ways of putting pipe in the ground; P&GJ takes a closer look at some of the best solutions of the past 12 months.

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Automatic Clock Thermostats: Lower Bills, Quick Pay-Out

P&GJ Staff Report

Horse sense tells us that judicious use of the home thermostat can help cut winter heating bills, and for many, that twist of the dial before retiring has become almost a reflex. Almost – but not always: People forget.

Automatic clock thermostats – the combination of thermostat and automatic timer – can be an easy, cost-effective means of reducing winter-season gas consumption and lowering the annual utility bill average. At $60 to $150 plus installation fee, the units are affordable to most homeowners, and pay-out can be quick: from one to two years, depending on how strictly they are used and on how much help they get from extra insulation, weatherstripping, "house-doctoring," etc.

These conclusions are drawn from a study* of potential home-heating savings in New York State, based on setting back temperatures at night and during periods when no one is home. Five cities were profiled – Albany, Buffalo, New York, Rochester, and Syracuse – and the figures for natural gas quoted by local and regional utilities. Estimates given are typical for a single-family residence in each of the five cities.

According to the study, up to 20% savings in home gas-heating costs can be achieved by lowering house temperatures for eight-hour periods during sleeping hours and when no one is home. This "dual setback" regimen requires four daily adjustments of the manual thermostat but can be programmed into any automatic clock-type unit to eliminate the probability of someone's forgetting to lower the setting. "Night setback" – a single, eight-hour period during sleeping hours – requires only two daily settings, either manually or programmed.

The study found that by lowering the temperature from 70 F to 60 F during sleeping hours and when no one is home, the typical Buffalo homeowner would accrue annual gas bill savings of $87 – a 17% reduction at Fall 1979 prices (see tables). Five-degree dual setback from 70 F to 65 F would save the Buffalo homeowner $56 (11%) annually while his New York counterpart would do even better, saving $86 (14%) for the same modest effort.

Ten-degree (70 F-60 F) night-only setback would produce $51 (10%) in yearly savings for the Buffalo homeowner, $74 (12%) for the New Yorker. In Buffalo, five-degree night-only setback is worth $31 (6%) annually and $49 (8%) in New York.

Typical price of an automatic clock thermostat is cited by the study at $75, excluding installation – a figure well within a one-year payback range for dual-setbacking homeowners. As filip for the energy conscious, the Internal Revenue Service extends an "energy credit" of 15% of purchase and installation costs for clock thermostats – even in rented houses. **P&GJ**

NEW YORK STATE AVERAGE GAS USAGE AND COST

City	Normal Degree Days Annually	Estimated Heating Usage in MMBtu/yr	×	Heating Cost Per MMBtu[1]	=	Annual Heating Cost[2]
Buffalo	6927	154		$3.32		$511
Albany	6888	153		$3.55		$543
Rochester	6719	151		$4.20		$634
Syracuse	6678	150		$3.55		$533
New York	4909	123		$5.00		$615

[1]Representative of Fall 1979 heating prices.
[2]Estimated gas-heating usage multiplied by heating cost.

NEW YORK STATE ANNUAL GAS SAVINGS – DUAL SETBACK

City	Average Annual Heating Cost	×	% Saved: 5-Deg Dual Setback	=	Annual Savings[1]	% Saved: 10-Deg Dual Setback	=	Annual Savings[1]
Buffalo	$511		11%		$56	17%		$ 87
Albany	$543		13%		$71	19%		$103
Rochester	$634		13%		$82	19%		$120
Syracuse	$532		13%		$69	19%		$101
New York	$615		14%		$86	20%		$123

[1]Percent multiplied by average annual heating cost.

NEW YORK STATE ANNUAL GAS SAVINGS – NIGHT SETBACK

City	Average Annual Heating Cost	×	% Saved: 5-Deg Night Setback	=	Annual Savings[1]	% Saved: 10-Deg Night Setback	=	Annual Savings[1]
Buffalo	$511		6%		$31	10%		$51
Albany	$543		7%		$38	11%		$60
Rochester	$634		7%		$44	11%		$70
Syracuse	$532		7%		$37	11%		$59
New York	$615		8%		$49	12%		$74

[1]Percent multiplied by average annual heating cost.

** "Reducing Home Heating Costs In New York State With Clock Thermostats," Energy Management Information Center, Honeywell Inc., Minneapolis, Minn. November 1979.*

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JULY 15, 1981

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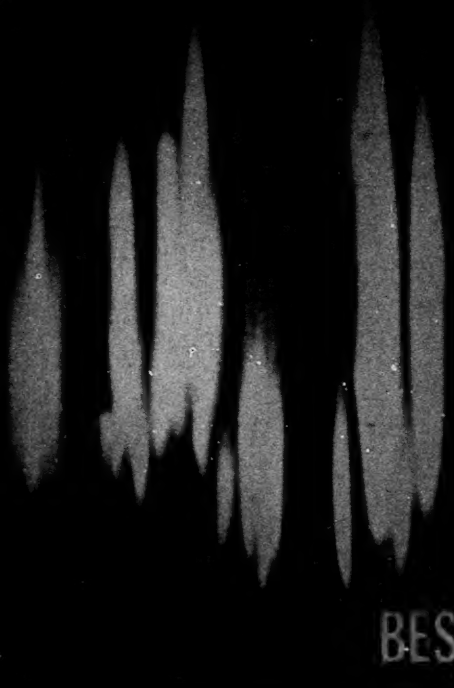

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ENERGY OPERATIONS & EQUIPMENT FORECAST

July 15, 1981

PIPELINE & GAS JOURNAL

–*Photo courtesy of Sandia National Laboratories*

ABOUT THE COVER: The name of the game is energy–and the world's energy firms continue to expand the search for both conventional and unconventional (even exotic) energy sources. Cover photo, made during studies of combustion at Sandia National Laboratories near Albuquerque, NM, symbolizes the final objective of energy exploration, production and transportation.

1 Overview of Oil/Gas Operations, Supply/Demand and Technical Advances
Editors focus on trends in rig activity, drilling/production technology, worldwide pipeline projects, U.S. gas supply and the international energy hunt.
Rotary Rigs Reflect Response to Decontrol
by Rich McNally, Associate Editor, PETROLEUM ENGINEER INTERNATIONAL
Operators Looking Everywhere for More Production
by W.B. Bleakley, Editor, PETROLEUM ENGINEER INTERNATIONAL
Pipeline Construction Activity Rated High
by Dean Hale, Editor, PIPELINE & GAS JOURNAL
Gas Distribution Growth Continues
by Jim Watts, Assistant Editor, PIPELINE & GAS JOURNAL
Free World Operations: Up, Up and Away
by Gregory Martin, Editor, ENERGY NEWS/ENERGY WEEK

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83 Cross-Country Pipelining/Gas Distribution
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125 Multiple-Use Tools
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009	029	049	069	089	109	129	149	169	189	209	229	249	269	289	309	329	349	369	389	409	429	449	469	489	509	529	549	569	589	609	629	649	669	689	709	729	749
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013	033	053	073	093	113	133	153	173	193	213	233	253	273	293	313	333	353	373	393	413	433	453	473	493	513	533	553	573	593	613	633	653	673	693	713	733	753
014	034	054	074	094	114	134	154	174	194	214	234	254	274	294	314	334	354	374	394	414	434	454	474	494	514	534	554	574	594	614	634	654	674	694	714	734	754
015	035	055	075	095	115	135	155	175	195	215	235	255	275	295	315	335	355	375	395	415	435	455	475	495	515	535	555	575	595	615	635	655	675	695	715	735	755
016	036	056	076	096	116	136	156	176	196	216	236	256	276	296	316	336	356	376	396	416	436	456	476	496	516	536	556	576	596	616	636	656	676	696	716	736	756
017	037	057	077	097	117	137	157	177	197	217	237	257	277	297	317	337	357	377	397	417	437	457	477	497	517	537	557	577	597	617	637	657	677	697	717	737	757
018	038	058	078	098	118	138	158	178	198	218	238	258	278	298	318	338	358	378	398	418	438	458	478	498	518	538	558	578	598	618	638	658	678	698	718	738	758
019	039	059	079	099	119	139	159	179	199	219	239	259	279	299	319	339	359	379	399	419	439	459	479	499	519	539	559	579	599	619	639	659	679	699	719	739	759
020	040	060	080	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600	620	640	660	680	700	720	740	760

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Rotary Rigs Reflect Response To Decontrol

by Rich McNally, *Associate Editor*
PETROLEUM ENGINEER International

Rowan Co.'s Rig 5 drilling the year's deepest well, GHK Co.'s 26,500-ft Harrell No. 1 and 2, in western Oklahoma.

Keeping up with the '80s will be no problem for America's oil and gas well drillers. But will the '80s be able to keep up with them?

By setting a new record for completions last year, U.S. drillers began the century's penultimate decade in high gear, and are showing no signs of slowing down as higher prices for domestic crude oil and for some categories of natural gas encourage close to 9000 oil and gas operators to employ the services of more than 700 contract drillers.

Last year, U.S. drilling contractors put down 189 million feet of hole to complete 62,462 wells. This represented a 19% increase over 1979's footage and a 21% increase over the earlier year's completion total.

As impressive as these figures are, however, they pale in comparison to cost data. Petroleum Information Corp. (Denver) puts 1980 drilling costs at $19.5 billion, a 41% increase over the $13.8 billion spent during 1979. And 1981 budgets are even higher, with 70,000 to 74,000 wells predicted for this year. This would bring drilling expenditures up to the $30 billion level for the year and continue a trend that could very well see a trillion dollars spent to drill and complete wells in the U.S. during the decade of the '80s.

Decontrol of oil prices, therefore, is achieving just about what the industry said it would. Higher prices and the promise of improved returns for investors have extended and expanded the search for new energy. The industry is not only going farther offshore, it also has begun exploring the complex structures of the Appalachian Basin as well as the Western Overthrust Belt. And exploration is going deeper in the conventional basins of Texas, Oklahoma, California, and Louisiana.

Although decontrol was a long time in coming, the delay provided the oilfield supply industry with plenty of time in which to gear up for the current boom. As a result, lead times associated with some of the major items of oilfield equipment are not regarded as serious enough to constrain drilling activity.

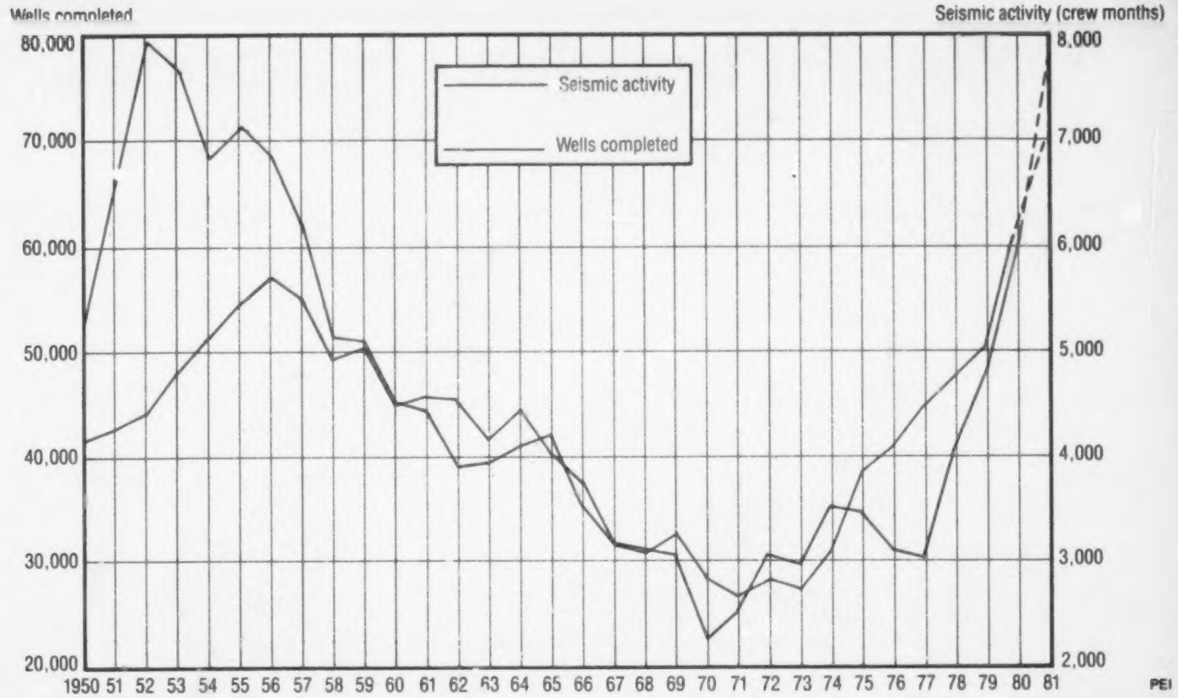
Perhaps the most critical constraints during the mini-booms of the '70s were shortages of oil country tubular goods, but indications are that domestic shipments plus imports will be sufficient to meet requirements for at least the first half of the '80s. Lone Star Steel Co. looks for drillers to consume 7.5 million tons of tubulars in 1985 while drilling 525 million feet of hole with 5740 rigs. Lone Star is one of a number of steel companies that have announced expansion plans during the past year (others include Armco and U.S. Steel), which should provide the necessary additional tubular capacity for the second half of the decade.

Shortages of qualified personnel were another constraint on drilling during the '70s, but it is not something that the industry hasn't been able to overcome. At one point early in the decade, the U.S. active rig count actually dropped below 1000, but today the industry is adding that many rigs each year. And it is coming up with the people to man them. Where they are coming from is anybody's guess, but the word we get from Wyoming is that the drilling boom in that state's portion of the Overthrust Belt is accompanied by a shortage of cowboys, who apparently are trading in their Stetsons and lassos for hard hats and spinning chains.

Drilling contractors, meanwhile, are stepping up their on-the-job training efforts, and there is growing interest in training simulators that will do the same job without sacrificing valuable rig time.

Although today's rig-building boom could result in a certain amount of overcapacity within the next few years, there appears to be little danger of overproduction of such consumable items as drilling bits, electronic logs, and drilling muds.

The contract research and development firm Gorham International Inc. of Gorham, Me., says that the future demand for mud minerals is "very bullish because drilling rates are up sharply, and because every well drilled requires 300 to 500



Close correlation between drilling and seismic activity is illustrated in this graph which shows both activities at their highest levels in 30 years.

tons of drilling fluid, regardless of whether that well is dry or becomes a gusher."

Rotary drilling is here to stay, for the foreseeable future at least, but a number of interesting bit developments are expected to have a definite impact on the drilling scene before long. Mud motors, for example, have been a staple in directional drilling for years, but motors available today are powerful enough for intensive long-term use, and there is growing interest in their ability to drill straight through tilted formations.

Another bit development that is attracting the attention of drilling contractors around the country is the artificial diamond blanks that offer both the hardness and abrasion-resistance of diamond and the impact-resistance of tungsten carbide. Bits with the Stratapax teeth are an added factor in the renewed popularity of mud motors for straight hole drilling because they require less weight in the drill string and less power on the bit.

So, things seem to be going the industry's way for a change. The U.S. drilling rig fleet now numbers more then 4000, with well over 3800 actively at work at mid-year. If the federal government chooses to continue lifting its heavy hand–repeal the "windfall profits" tax, for example, and throw out complicated and inconsistent restrictions on natural gas pricing – most industry authorities agree that the drilling effort will continue to surge.

With market forces in command, the industry would have the incentive to drill 100,000 wells each year for 40 years, according to George P. Mitchell, president of Mitchell Energy & Development Corp. "And when we're drilling at the rate of 100,000–an amount the nation's geology can support," Mitchell says, "OPEC's clout will be softened beyond recognition. In the year just ended, with a record number of wells, we stopped the downward trend in oil production and almost did it in gas production. In the present year (1981), I believe the industry will drill 10,000 more wells than in 1980. And when we reach an annual rate of 85,000 wells a year, we'll find as much natural gas as we're using."

Another call for removal of restraints on energy production comes from Charles J. DiBona, president of the American Petroleum Institute. He says, "For the country to take full advantage of the stimulus that market forces are giving to drilling, there must be some changes in government policy.

"To cut imports in half by 1990," he says, "there is need for more energy from federal lands, a better balance between environmental progress and resource development, and consistent, timely government decisions on nuclear regulatory questions."

The leading indicator of future drilling activity, of course, is the number of seismic crews active at any one time. Here, too, the outlook can only be described as bullish. Word just in from the Society of Exploration Geophysicists reflects a dramatic increase in the number of seismic land crews and marine vessels searching for oil and gas in the U.S. and offshore. The total increased from 610 in March to 645 during April, the highest total since the third quarter of 1953. This represents a 30% increase over April 1980, and 79% over April 1979.

All signals are "go" for drilling in the '80s – even without repeal of the "windfall profits" tax, because institutional investors from outside the industry stand ready to pick up the slack by investing in oil and gas exploration as a means of keeping pace with inflation.

The petroleum industry is ready, willing, and able to fuel the U.S. economy through what promises to be a turbulent decade. The only question is whether the '80s will come through with the proper climate for the necessary drilling effort. An effort which will not only be expensive, but which will set new standards for equipment, technology, and people. ■

Pipeline Construction Activity Rated High

by Dean Hale, *Editor, PIPELINE & GAS JOURNAL*

At mid-1981 over 81,000 miles of crude oil, refined products, natural gas, and slurry pipelines are planned or under construction around the world. More than $12.3 billion will be spent during the year to install an estimated 23,990 miles of cross-country pipelines of all types.

In the United States, that includes 10,440 miles of liquids and gas pipelines costing more than $2.52 billion. Outside the U.S., some 13,550 miles of new pipelines will be installed at a cost exceeding $9.7 billion.

The trend for the remaining two decades of this century is for more and more–more pipelines of all kinds to transport an increasing number of commodities. Those commodities include the perennial favorites – crude oil, refined products, natural gas liquids, natural gas, and coal slurries–plus chemicals of all types, ammonia, industrial gases such as oxygen and nitrogen, carbon dioxide (to be used for enhanced recovery of oil), solids slurries including ores and other non-soluble minerals, and even such items as wood chips.

In a major study of U.S. and Canadian pipeline requirements to the turn of the century, Bechtel's Peter G. Behr and Steven Davenport *(see Pipeline & Gas Journal, June 1981)* estimate a minimum of 33 major inter-regional pipeline projects, involving 50,300 miles, will be needed by the year 2000. This projection includes 8 oil pipeline projects totalling 8900 miles; 11 gas pipeline projects totalling 26,000 miles, and 14 slurry pipeline projects totalling 15,400 miles.

PIPELINE & GAS JOURNAL estimates that some 200,000 total miles of new cross-country pipelines will be needed during the 1981 to 2000 period–including major interregional lines, intra-regional lines, loops on existing systems, additional offshore pipelines, and gathering system lines – an average of 10,000 miles per year.

"Super projects" such as the Alaska Highway Gas Pipeline Project will continue to capture the spotlight, but the bread-and-butter pipeline activity will keep the manufacturers of pipe, valves, fittings, pumps, compressors, coatings, and construction machinery in business and help pay the bills.

Internationally, pipeline activity continues to grind away at a steady pace with many new, moderately sized projects announced, plus a few undertakings somewhat more grandiose. Nigeria, frustrated by an inability to get a long-planned LNG export plant and terminal built or financed, now proposes to build a 2500-mile, 40 to 48-in. gas pipeline across western Africa from the Bonny area to the Mediterranean, with branches connecting to either (or both) the Trans-Mediterranean Gas Pipeline and the SEGAMO project proposed to Spain and France (involving a very deep line across the Mediterranean).

In West Germany, two liquid lines are in the news — an 81-mile, 22-in. crude oil line from Wilhelmshaven to Hamburg, proposed by Esso AG and Deutsche BP, and a 186-mile LPG line from Wilhelmshaven to the Ruhr, planned by Mobil Oil AG and Industrieverwaltangs GmbH.

Crude oil and products lines occupy headlines elsewhere. In Panama, work is underway and pipe ordered for a 78-mile, 36-in. line across the Isthmus that will permit bypassing of the crowded Panama Canal. In Colombia, ECOPETROL is planning a 186-mile, $47 million crude line. In Australia, a 240-mile crude oil and condensate line is now planned from Moomba in the Cooper Basin to Stoney Point in South Australia, site of a new refinery. New Zealand is the site for a $55 million, 101-mile products line from Marsden Point to Auckland.

Argentina, where 1240 miles of 30-in. and smaller lines are now under construction, is planning another 1000 miles of 30-in. and larger system to feed natural gas to Sao Paulo, Brazil, and to several Uruguayan cities as part of a massive export program. The Soviet Oil and Gas Ministry has announced that it will build 31,000 miles of gas pipelines during 1981-1985, most of them in western Siberia; the plan does not include the 2000-mile, $11 billion Yamul Peninsula-to-Europe project currently being studied and promoted.

In the North Sea, work is underway on 44 miles of 24-in. from the West Sole Field to Easington, U.K., and government, British Gas, and private interests continue to debate the merits of a 600-mile major offshore gas gathering system. Success of the gas gathering system would depend, partially, on whether Norway will commit gas from the Statfjord re-

1981 Pipeline Construction

(Estimated Miles Completed During Year)

	U. S.	International	Total
Gas			
Transmission	3610	3177	6787
Field, Gathering, Storage	1850	1950	3800
Total	**5460**	**5127**	**10587**
Crude			
Trunk	412	2860	3272
Gathering	1590	1800	3390
Total	**2002**	**4660**	**6662**
Products			
Refined Products	785	1090	1875
LPG/NGL	1380	1545	2925
Total	**2165**	**2635**	**4800**
Offshore			
Oil	181	518	699
Gas	634	610	1244
Total	**815**	**1128**	**1943**
GRAND TOTAL	**10,442**	**13,550**	**23,992**
Prime Movers (Est. HP Installed)			
Compressor	401,000	720,000	1,121,000
Pump	228,800	183,000	411,800
Total	**629,800**	**903,000**	**1,532,800**

serves. Norway, on the other hand, is carefully studying its options, including building a major gas pipeline link to Ekofisk (with gas then going to Emden via an existing gas pipeline) and a gas pipeline across the Norwegian Trench to the Norwegian mainland. Whatever happens must happen by 1985-86, at which time the reinjection of gas into the Statfjord reservoir will have to be discontinued to prevent damage to the formation.

British Gas currently is completing work on the remainder of its 280-mile, 42-in. Fourth Feeder from St. Fergus *(see May 1981 issue of P&GJ)*. In Italy, crews are working on six major sections of the 48-in. Trans-Mediterranean Gas Pipeline for SNAM and plan to have the line complete to the Rome area by year's end.

In Brazil, work continues on the 280 miles of 12 through 24-in. being installed at Campos Basin. In Mexico, Pemex has 342 miles of major 48-in. gas pipeline underway, and another 2667 miles of various sizes of gas and products lines. In Spain, ENAGAS has announced plans for a 155-mile gas pipeline south of Madrid to Catagena and Marcia and a 150-mile line from Madrid to Burgos. Kuwait has announced plans for some 60 miles of new offshore/onshore gas pipelines.

Victoria Gas & Fuel Corp. of New Zealand has announced plans for 55 miles of 30-in. gas line to be completed by 1983. In Australia, work will get underway in January on the 81-mile, 36-in. pipeline to bring Northwest Shelf gas to shore. Meanwhile, planning and design work continues on the 940-mile 26 or 30-in. pipeline that will take the gas from near Dampier southward to Perth.

Pipeline activity in the Middle East has slowed somewhat, with completion of the Petromin 48-in. crude oil line (800 miles) and the Aramco 747-mile NGL line, both terminating at Yanbu on the Red Sea. In Abu Dhabi, work is nearing completion on ZADCO's 746 miles of 4 to 48-in. Several major gas and NGL lines in Algeria are under construction, with completion dates varying from fall 1981 to late 1982.

Domestically, the "big" project—the Alaska Highway Gas Pipeline—has its "below the border" sections well underway, plus a substantial amount of work in progress in Alberta, British Columbia, and Saskatchewan. The 161-mile western leg (Pacific Gas Transmission) will be complete by late summer and the 823-mile Northern Border Pipeline from Ventura, Iowa to Monchy, Sask. will be ready by year's end. Nova Corp. has 395 miles of 42-in. underway on its eastern leg from Monchy, Sask., to Caroline, Alta.

The big pipeline, now estimated to cost $30 billion, reports progress in obtaining financing. Three major gas producers at Prudhoe Bay–Exxon, ARCO, and Sohio–will have a 30% ownership in the line. Design of the huge gas processing plant at Prudhoe Bay, a major step in getting the line into operation, is well underway by the Parsons Co. of Pasadena, Calif.

Numerous new gas pipeline projects have been announced as exploration and drilling around the nation turn up substantial new reserves. El Paso Natural Gas is building 107 miles of 20-in. and adding 3500 hp that will give it access to considerable reserves in the Anadarko Basin. American Natural is planning a 375-mile, 24-in. "Pathfinder" pipeline from near Cheyenne, Wyo. southeast to Greensburg, Kansas. The Trailblazer pipeline project–797 miles of 30 and 36-in. to move Overthrust Belt gas from the Wyoming-Utah-Colorado area to Midwest markets, remains on tap, as do the Rocky Mountain Pipeline (695 miles of 20, 30, and 36-in.) proposed by Pacific Gas Transmission, and the Trans-Anadarko Pipeline System involving 635 miles of 36-in.

Northwest Pipeline Co. has completed 340 miles of 24 and 30-in., while Florida Gas is awaiting approval on 309 miles of 30-in. loops on its system, and Colorado Interstate Gas Co. is planning 300 miles of 26 and 30-in. loops on its system. Boundary Gas Co., to be built and operated by Tennessee Gas Pipeline and owned by 14 gas companies, is planning 294 miles of 10, 12, 26 and 30-in.

Northern Tier Pipeline expects action this year on its proposal to build a 1550-mile, 40 and 42-in. crude oil line from the Seattle area to Clearbrook, Minn. Western Crude Oil of Denver is building 115 miles of 10-in. from Medford, Okla., to Conway, Kan., and another 47 miles of line in South Texas near Giddings.

Energy Transportation Systems, Inc. expects to receive its final EIS from the Bureau of Land Management in late July. The ETSI system is in the final design stage and ROW acquisition is underway. Work on the coal slurry line is expected to begin in 1982.

Canadian pipeline activity is at its best in recent years. In addition to the nearly 400 miles of 42-in. underway by Nova on the Alaska Highway Gas Pipeline Project, TransCanada PipeLines has 64 miles of 48-in. loop underway and plans another 221 miles of 42 and 48-in. loop later this year. First stage of the Quebec and Maritimes gas line–100 miles of 30-in. – may also be underway this year. TransCanada also has proposed a 235-mile, 42-in. "shortcut" from North Bay to Morrisburg (southeast of Ottawa) that may see action this year.

British Columbia Hydro has won approval for a 212-mile, 12, 16, and 24-in. system to bring gas from the mainland to Vancouver Island at a cost of $231 million. Not to be forgotten is the Polar Gas Project, involving some 2300 miles of 36 to 48-in. pipeline, that is still under study.

Liquids pipelines projects include a dual 89-mile system from Lloydminster to Cold Lake for Husky Oil involving a 6-in. condensate line and a 12-in. heavy oil + condensate return line. Similarly, Alberta Energy will build a dual 145-mile system from Cold Lake to Edmonton, also with a 6-in. condensate line and a 12-in. heavy oil + condensate return line.

Alberta Products Pipeline is currently building a 196-mile, 10-in. products line from Edmonton to Calgary. Dome Petroleum, Westcoast Transmission, and Canadian Occidental Petroleum Ltd. reportedly are planning a 500-mile, 10-in. line to transport NGL from Prince George, B.C. to Prince Rupert and Kitimat, B.C. And, finally, approval has been given for a $360 million crude oil line from Norman Wells to Northern Alberta, to be built by Interprovincial Pipeline.■

Gas Distribution Growth Continues

by Jim Watts, *Assistant Editor, Pipeline & Gas Journal*

Statistics can be confusing, but the trend of figures relating to gas distribution tell an easy-to-read story: customers, industrial as well as residential, realize gas is efficient, available, and all in all, very cheap for the price.

Residential demand is still good, despite a depressed new housing market due to high interest rates, and conversions are high as more and more customers move away from expensive oil and electricity. Gas utilities will add 650,000 to 750,000 customers during 1981, down from the 820,000 added during 1980. More than $2.019 billion will be spent during the year on 29,219 miles of new distribution piping and outlays for maintenance of the nation's 1.35 million miles of existing services. Total number of customers served as of Dec. 31, 1980, was more than 46.7 million.

The 1981 estimate is 13.05% higher than the $1.786 billion spent for new and replacement mains and services and system maintenance in 1980, and expenditures in 1980 were a record 14.6% higher than the expenditures in 1979 of $1.558 billion. Increasing budgets reflect demand for gas energy in an economy that still has to pick itself up, and also that inflation is continuing to add to the burden of paying for ever more expensive labor, materials, and construction equipment.

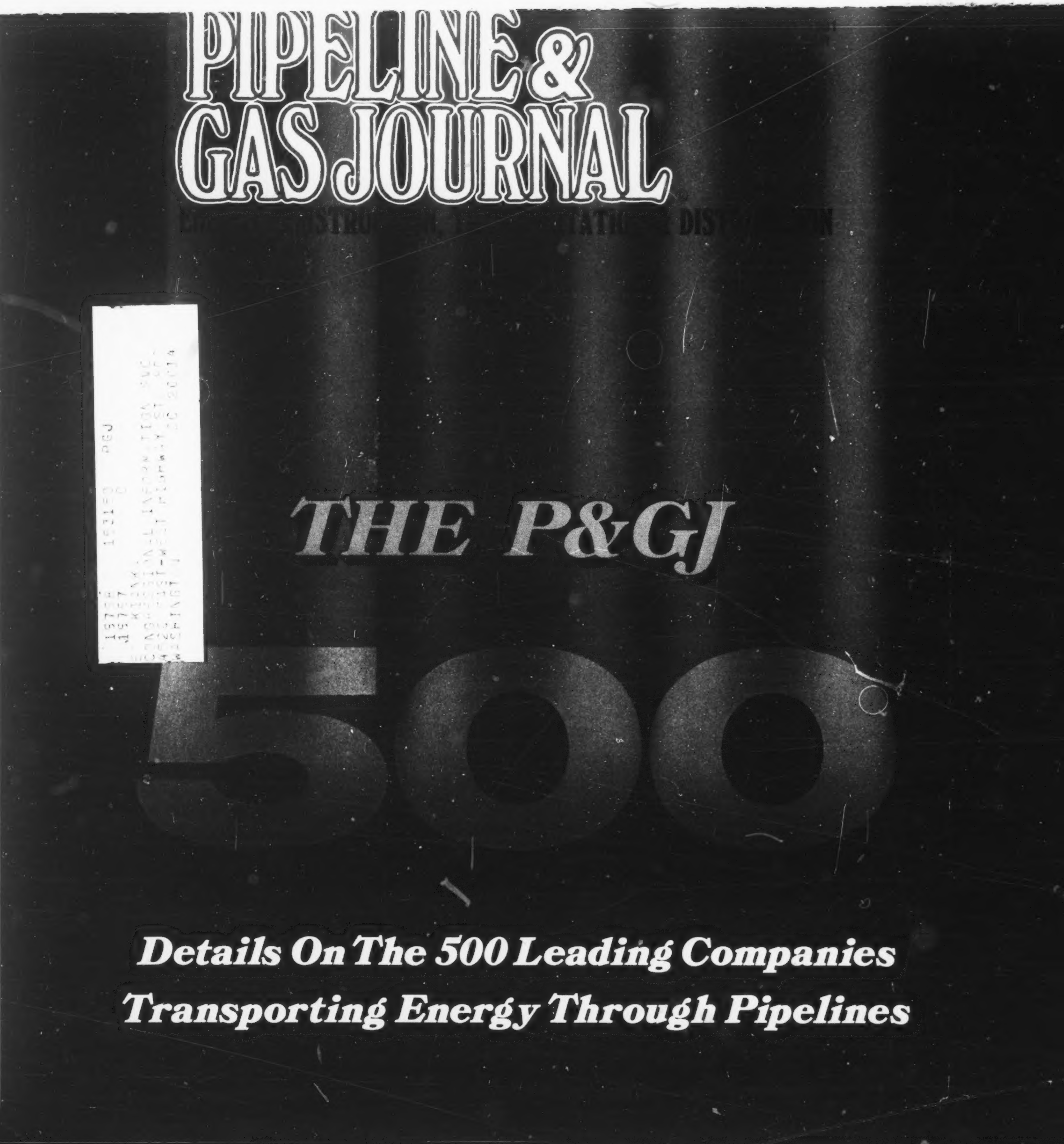
One of the ways the industry is fighting inflation is with plastic pipe, which is cheaper than steel pipe and can be installed easier and without highly specialized skills, such as welding. More than 78% of all the pipe installed in 1980 was plastic, the seventh year in a row that plastic pipe accounted for more than half the pipe installed. In 1981, utilities plan to install 22,234 miles of plastic pipe to add to the 176,087 miles currently in the ground.

American Gas Association's latest capital expenditures outlook anticipates more than $401 billion in gas industry expenditures between 1981 and 2000, of which a projected $124 billion (or more than $6 billion a year) will go into construction and maintenance of cross-country pipelines and utility mains and services.

Peakshaving supplies are ample to protect the 46.7 million customers, 38 million of whom heat their homes with natural gas. Underground gas storage, propane-air, peakshaving LNG, and other supplemental fuels totaled 71.68 Bcf during the 1980-81 winter, up from 69.86 Bcf in the 1979-80 winter. Major U.S. utilities such as Southern California Gas Co., Columbia Gas System, El Paso Natural Gas Co., and others will spend nearly $328.1 million in 1981 for underground gas storage and related facilities. ■

U.S. GAS DISTRIBUTION PIPING — 1980-1989

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Projection										
Miles of Gas Mains Installed	13,573	13,744	14,900	14,800	14,400	14,600	14,200	14,200	14,700	15,100
Miles of Gas Services Installed	14,379	15,475	14,200	14,600	14,700	15,000	15,600	15,550	15,900	15,900
Total	**27,952**	**29,219**	**29,100**	**29,400**	**29,100**	**29,600**	**29,800**	**29,750**	**30,600**	**31,000**
Construction Expenditures, Distribution ($Billion)	1.761	2.019	2.381	2.646	2.987	3.402	3.870	4.299	4.872	5.370



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THE P&GJ 500

Details On The 500 Leading Companies Transporting Energy Through Pipelines

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The P&GJ 500

Dimensions Of The 500 Leading Companies Transporting Energy Through Pipelines

by **Dean Hale**, *Editor*

America's energy pipeline network is vast and growing. It reaches into every nook and cranny of the 48 contiguous states plus Alaska and Hawaii. There are over 2000 owner/operator entities involving more than 1,448,000 miles of gas mains, gas transmission pipelines, and liquid pipelines.

To provide a more definitive reading of the dimensions of this great resource, PIPELINE & GAS JOURNAL has surveyed the leading firms operating these facilities to determine the 300 leading gas distribution utilities, the 100 leading gas transmission pipelines, and the 100 leading liquid (crude oil and products) pipelines.

The P&GJ 500 represent the leaders; they operate 74.4% of all liquids pipeline mileage, 78.2% of all gas pipeline mileage, and serve 97.3% of the nation's gas utility customers.

Dimensionally, the P&GJ 500 study provides a comparative insight covering revenues, gas sales (in MMcf per year), number of customers, net income, plant value, capital expenditures in terms of plant additions, and physical facilities in terms of miles of gas mains or miles of pipelines.

Gas Distribution Utilities. The nation's leading 300 gas distribution utilities covered in the P&GJ 500 report range in size from 3,793,062 customers to 4,043 customers. The top 300 (out of a total 1559 gas utilities in the U.S.) operate 657,984 miles of gas main – some 80.2% of the estimated 820,200 miles now in service.

California leads the top 300 list – Southern California Gas Co. is No. 1 in customers, sales, and miles of main. Pacific Gas & Electric, is No. 2 in the list.

Gas Transmission Pipelines. Largest in terms of total miles operated is InterNorth, Inc., followed by El Paso Natural Gas Co., which ranks No. 1 in gas sales and operating revenues. Tenneco, Inc. is No. 2 in sales. In capital expenditures, InterNorth ranks first, followed by Michigan Wisconsin Pipe Line Co.

Liquids Pipelines. In terms of mileage, Amoco Pipe Line Co. is No 1 with 12,924 miles, followed by Mobil Pipe Line Co. Leader in crude oil deliveries is Arco Pipe Line Co., followed by Exxon Pipe Line Co. Colonial Pipe Line Co., operator of the nation's major products system from Houston to New Jersey, ranks first in products deliveries, followed by Buckeye Pipe Line Co.

The following summary tables provide an overview of the "top 10" companies in numerous categories; the complete tabular presentations provide a fuller dimensional measure of the P&GJ 500.

The 10 Biggest Spenders – Gas Distribution Utilities
(not including integrated companies)

Rank	Company Name	1980 Additions To Plant, $(000)
1	Northern Illinois Gas Co.	125,261
2	Southern California Gas Co.	119,036
3	Columbia Gas Distribution Companies	53,436
4	Consolidated Edison Co. of NY	45,772
5	Brooklyn Union Gas Co.	44,792
6	Public Service Gas & Electric	44,415
7	Peoples Gas Light & Coke Co.	43,871
8	Philadelphia Electric	38,833
9	Atlanta Gas Light Co.	32,413
10	Northwest Natural Gas Co.	30,638

The 10 Biggest Spenders – Gas Transmission Pipelines
(not including integrated companies)

Rank	Company Name	1980 Additions To Plant, $(000)
1	Internorth, Inc.	238,122
2	Michigan Wisconsin Pipeline Co.	232,207
3	Transcontinental Gas Pipeline Corp.	144,553
4	Columbia Gas Transmission Co.	138,607
5	Tenneco, Inc.	121,612
6	Natural Gas Pipeline Co. of America	106,348
7	Panhandle Eastern Pipeline Co.	102,352
8	Trunkline Gas Co.	97,406
9	Southern Natural Gas Co.	93,947
10	United Gas Pipeline Co.	83,229

The 10 Biggest Spenders – Liquids Pipeline Companies

Rank	Company Name	1980 Additions To Plant, $(000)
1	Colonial Pipeline Co.	140,633
2	MAPCO	112,696
3	Arco Pipe Line Co.	87,278
4	Wood River Pipeline Corp.	71,651
5	Phillips Pipe Line Co.	70,411
6	Exxon Pipeline Co.	58,917
7	Sohio Pipeline Co.	43,168
8	Amoco Pipeline Co.	33,757
9	Shell Pipe Line Co.	29,622
10	Gulf Refining Co.	23,556

The Top 10 In Revenues – Gas Distribution Utilities

Rank	Company Name	1980 Revenues, $(000)
1	Southern California Gas Co.	3,197,436
2	Public Service Electric & Gas	2,994,053
3	Columbia Gas Distribution Companies	2,015,984
4	Consolidated Gas Supply Corp.	1,708,937
5	Northern Illinois Gas Co.	1,578,022
6	Northern Indiana Public Service Co.	1,366,525
7	Baltimore Gas & Electric Co.	1,226,442
8	Peoples Gas Light & Coke Co.	1,117,613
9	Public Service Co. of Colorado	1,058,942
10	Illinois Power Co.	883,370

The Top 10 Gas Distribution Utilities In MMcf Gas Sales

Rank	Company Name	1980 Sales MMcf
1	Southern California Gas Company	883,263
2	Pacific Gas & Electric Co.	797,755
3	Columbia Gas Distribution Companies	733,287
4	Lone Star Gas Company	545,916
5	Northern Illinois Gas Co.	486,169
6	Michigan Consolidated Gas Co.	426,851
7	Boston Gas Company	403,400
8	Consumers Power Co.	340,763
9	East Ohio Gas Co.	329,900
10	Peopies Gas Light & Coke Co.	307,938

The Top 10 Gas Distribution Utilities In Miles of Main

Rank	Company Name	Miles of Main
1	Southern California Gas Co.	34,412
2	Pacific Gas & Electric Co.	29,319
3	Columbia Gas Distribution Companies	27,320
4	Northern Illinois Gas Co.	23,602
5	Entex	21,208
6	Consumers Power Co.	19,224
7	Atlanta Gas Light Co.	16,069
8	Arkansas Louisiana Gas Co.	14,425
9	East Ohio Gas Co.	13,382
10	National Fuel Gas Distribution Co.	12,686

The 10 Largest Combination Gas & Electric Utilities

(Ranked By Number of Gas Customers)

Rank	Company Name	No. of Customers	MMcf Sales	Miles of Mains
1	Pacific Gas & Elec. Co.	2,858,129	797,755	29,319
2	Public Service Elec. & Gas	1,306,952	197,970	12,369
3	Consumers Power Co.	1,138,109	340,763	19,224
4	Cons. Edison of N.Y.	1,024,003	83,941	4,197
5	Public Service of Colo.	627,267	167,994	10,435
6	Northern Indiana Publ. Serv.	521,770	255,730	10,457
7	Baltimore Gas & Elec. Co.	510,451	95,110	4,235
8	San Diego Gas & Elec.	504,016	88,483	4,938
9	Niagara Mohawk Power	423,035	101,321	6,063
10	Long Island Lighting	387,310	43,625	5,676

The Top 10 In Revenues – Gas Transmission Pipelines

Rank	Company Name	1980 Revenues $(000)
1	El Paso Natural Gas Co.	2,932,489
2	Columbia Gas Transmission Co.	2,822,340
3	Tenneco, Inc.	2,552,637
4	Transcontinental Gas Pipe Line Corp.	2,536,088
5	United Gas Pipe Line Co.	2,462,826
6	Texas Eastern Transmission Corp.	2,068,579
7	Michigan Wisconsin Pipe Line Co.	1,951,108
8	Internorth, Inc.	1,739,805
9	Panhandle Eastern Pipeline Co.	1,515,496
10	Texas Gas Transmission Corp.	1,353,725

The Top 10 Gas Transmission Pipelines In MMcf Gas Sales

Rank	Company Name	1980 Sales MMcf
1	Columbia Gulf Transmission Co.	1,410,448
2	El Paso Natural Gas Co.	1,181,133
3	Tenneco, Inc.	1,113,322
4	Columbia Gas Transmission Co.	1,068,265
5	United Gas Pipeline Co.	1,020,879
6	Texas Eastern Transmission Corp.	931,250
7	Transcontinental Gas Pipeline Corp.	890,583
8	Internorth, Inc.	755,302
9	Michigan Wisconsin Pipeline Co.	674,855
10	Panhandle Eastern Pipeline Co.	664,987

The 10 Largest Integrated Gas Utilities

Rank	Company Name	No. of Customers	MMcf Sales	Miles of Mains	Miles of Trans. Lines	Additions To Plant $(000), 1980
1	Pacific Gas & Electric Co.	2,858,129	797,755	29,319	4,765	135,832
2	Lone Star Gas Co. (Enserch)	1,174,686	545,916	2,736	11,480	61,391
3	Consumers Power Co.	1,138,109	340,763	19,224	1,244	61,430
4	Michigan Consolidated Gas Co.	1,056,357	426.851	12,616	2,312	74,641
5	Arkansas Louisiana Gas Co.	703,152	301,449	14,425	9,028	81,406
6	National Fuel Gas Distribution Corp.	667,868	193,685	12,686	1,517	36,741
7	Oklahoma Natural Gas (Oneok, Inc.)	586,151	274,663	9,965	4,896	35,579
8	Mountain Fuel Supply	395,586	140,320	11,587	1,764	61,516
9	Southwest Gas Corp.	335,102	98,500	6,900	1,571	19,872
10	Pioneer Corp.	275,000	163,408	4,278	11,118	7,921

The P&GJ 500 ... dimensions of the pipeline energy business

The Top 10 Liquids Pipelines – Revenues

Rank	Company Name	1980 Revenues $(000)
1	Sohio Pipeline Co.	1,151,533
2	Arco Pipeline Co.	833,733
3	Exxon Pipe Line Co.	790,968
4	BP Pipelines Inc.*	556,820
5	Colonial Pipeline Co.	338,353
6	Mobil Alaska Pipeline*	167,224
7	Amoco Pipeline Co.	143,425
8	Lakehead Pipeline Co.	136,709
9	Williams Pipe Line Co.	132,486
10	Shell Pipe Line Co.	119,890

**Represents firm's share of trans-Alaska oil pipeline (Alyeska) revenues.*

The Top 10 Liquids Pipelines – In Mileage

Rank	Company Name	Total Miles Of Pipeline
1	Amoco Pipeline Co.	12,924
2	Mobil Pipeline Co.	11,783
3	Exxon Pipeline Co.	9,063
4	Williams Pipe Line Co.	8,273
5	Arco Pipeline Co.	8,208
6	Shell Pipe Line Co.	7,828
7	MAPCO	7,606
8	Continental Pipe Line Co.	7,489
9	Phillips Pipe Line Co.	5,932
10	Colonial Pipeline Co.	5,194

The Top 10 Products Pipeline Companies

Rank	Company Name	1980 Deliveries, (000) Bbl Products
1	Colonial Pipeline Co.	632,497
2	Buckeye Pipeline Co.	281,524
3	Gulf Refining Co.	233,199
4	Southern Pacific Pipelines, Inc.	227,338
5	Marathon Pipeline Co.	183,966
6	Plantation Pipeline Co.	182,250
7	Texas Pipeline Co.	161,368
8	Williams Pipe Line Co.	161,203
9	Arco Pipeline Co.	145,281
10	MAPCO	131,346

The Top 10 Crude Pipelines

Rank	Company Name	1980 Deliveries, (000) Bbl Crude
1	Arco Pipeline Co.	520,105
2	Exxon Pipeline Co.	497,235
3	Lakehead Pipeline Co.	461,018
4	Shell Pipeline Co.	393,904
5	Amoco Pipeline Co.	387,187
6	Marathon Pipeline Co.	320,567
7	Texas Pipeline Co.	314,716
8	Sohio Pipeline Co.	269,771
9	Gulf Refining Co.	260,216
10	Mobil Pipeline Co.	256,388

The 300 Leading Gas Distribution Utilities

Rank	Name of Company	Number of Customers	1980 Gas Sales, MMcf	1980 Oper. Revenues $ (000)	1980 Net Income $ (000)	Gas plant value $ (000) 12-31-80	Additions to plant $ (000)	Miles of Mains	Miles of Services
1	Southern Calif. Gas Co.	3,793,062	883,263	3,197,436	58,623	1,085,880	119,036	34,412	36,008
2	Pacific Gas & Electric Co.	2,858,129	797,755	2,947,009	135,867	2,130,917	125,394	29,319	23,304
3	Columbia Gas Distribution Cos.	1,840,589	733,287	2,015,984	44,500	657,337	53,436	27,320	N/A
4	Northern Illinois Gas Co.	1,441,606	486,169	1,578,022	72,767	1,553,585	125,261	23,602	18,996
5	Public Service Electric & Gas Co.	1,306,952	197,970	2,994,053[E]	281,716	1,000,222	44,415	12,369	12,274
6	Entex, Inc.	1,180,676	178,057	824,068	39,335	430,076	31,000	21,208	N/A
7	Lone Star Gas Co.	1,174,686	545,916	1,435,430	52,905	748,724	61,391	2,736	16,483
8	Consumers Power Co.	1,138,109	340,763	981,350	65,427	1,195,296	61,430	19,224	N/A
9	Brooklyn Union Gas	1,061,208	107,248	688,253	38,932	624,479	44,792	3,788	5,217
10	Michigan Consolidated Gas Co.	1,056,357	426,851	1,414,787	14,863	1,342,445	74,461	12,616	13,827
11	Consolidated Edison Co. of NY, Inc.	1,024,003	83,941	460,846	34,668	554,130	45,772	4,197	2,395
12	East Ohio Gas Co.[A]	980,013	329,900	1,100,031	N/A	428,079	N/A	13,382	N/A
13	The Peoples Gas Light & Coke Co.	884,085	307,938	1,117,613	30,731	889,566	43,871	4,042	5,123
14	The Gas Service Co.	842,460	224,167	539,112	7,663	260,400	24,261	12,670	5,423
15	Atlanta Gas Light Co.	794,202	227,213	699,544	16,473	495,677	32,413	16,069	14,209

Footnotes:

A. 1979 data
B. Estimated
C. Fiscal year ending 6-30-80
D. Fiscal year ending 9-30-80
E. Gas and electric revenues combined.
F. Fiscal year ending 3-31-81.

The P&GJ 500 ... dimensions of the pipeline energy business

Rank	Name of Company	Number of Customers	1980 Gas Sales, MMcf	1980 Oper. Revenues $ (000)	1980 Net Income $ (000)	Gas plant value $ (000) 12-31-80	Additions to plant $ (000)	Miles of Mains	Miles of Services
16	Arkansas Louisiana Gas Co.	703,152	301,449	801,897	73,426	897,825	81,406	14,425	N/A
17	National Fuel Gas Dist. Corp.	667,868	193,685	691,073	8,177	416,961	36,741	12,686	N/A
18	Public Service Co. of Colorado	657,267	167,994	1,058,942^{E}	85,027	304,868	17,041	10,435	N/A
19	Oklahoma Natural Gas Co.	586,151	274,665	860,054	40,279	507,252	35,579	9,965	1,618
20	Southern Union Gas Co.	564,260	185,646	372,249	N/A	N/A	N/A	1,586	N/A
21	**Minnesota Gas Co.**	**558,358**	**151,034**	**435,091**	**17,700**	**338,106**	**22,138**	**7,758**	**N/A**
22	**Washington Gas Light Co.**	**554,342**	**110,164**	**463,995**	**18,086**	**607,049**	**57,162**	**5,762**	**N/A**
23	**Philadelphia Gas Works**	**540,289**	**86,538**	**289,720**	**N/A**	**N/A**	**N/A**	**2,932**	**3,207**
24	**Laclede Gas Co.^{D}**	**540,138**	**120,143**	**423,842**	**15,692**	**377,152**	**16,124**	**5,957**	**5,656**
25	**Northern Indiana Public Serv. Co.**	**521,770**	**255,730**	**1,366,525^{E}**	**72,230**	**572,590**	**33,334**	**10,457**	**9,844**
26	Baltimore Gas & Electric Co.	510,451	95,110	1,226,442^{E}	139,399	332,829	18,272	4,235	4,401
27	San Diego Gas & Electric Co.	504,016	88,483	299,036	16,563	154,297	18,930	4,938	4,028
28	Boston Gas Co.	477,812	403,400	368,952	19,097	304,529	16,569	5,700	7,540^{B}
29	Niagara Mohawk Power Corp.	423,035	101,321	383,648	15,244	404,290	29,653	6,063	3,910
30	Wisconsin Gas Co.	404,467	127,112	450,284	13,327	357,040	15,872	5,900	N/A
31	**Mountain Fuel Supply Co.**	**395,586**	**140,320**	**399,595**	**30,851**	**532,688**	**57,621**	**11,537**	**N/A**
32	**Long Island Lighting Co.**	**387,310**	**43,625**	**182,990**	**N/A**	**N/A**	**N/A**	**5,676**	**5,027**
33	**Illinois Power Co.**	**381,849**	**97,728**	**883,370^{E}**	**113,562**	**327,991**	**18,406**	**7,109**	**4,940**
34	**Alabama Gas Corp.**	**352,479**	**89,413**	**295,958**	**5,258**	**111,668**	**8,993**	**6,094**	**6,907**
35	**Arizona Public Service Co.**	**340,248**	**43,227**	**143,895**	**5,530**	**38,366**	**17,692**	**6,201**	**3,926**
36	Southwest Gas Corp.	335,102	98,500	317,549	8,861	306,200	19,872	6,900^{B}	N/A
37	Peoples Natural Gas Co.	315,000	120,476	328,219	N/A	N/A	N/A	2,339	4,771
38	Cincinnati Gas & Electric Co.	300,581	87,023	879,445^{E}	89,980	179,100	14,125	3,407	813
39	Indiana Gas Co.	291,320	96,560	224,759	18,946	246,738	16,402	6,229	4,460
40	Peoples Natural Gas Div., Internorth	291,058	16,351	399,956	5,530	126,012	20,000	9,617	3,396
41	**Philadelphia Electric Co.**	**283,789**	**69,114**	**290,743**	**22,511**	**332,599**	**38,833**	**4,269**	**2,979**
42	**Pioneer Corp.**	**275,000**	**163,408**	**559,452**	**90,556**	**278,901**	**7,921**	**4,278**	**564**
43	**Northern States Power Co.**	**270,299**	**71,123**	**233,809**	**9,925**	**227,648**	**25,079**	**4,003**	**2,892**
44	**The Dayton Power and Light Co.**	**263,835**	**58,024**	**650,000^{E}**	**64,171**	**75,047**	**7,087**	**3,770**	**733**
45	**San Antonio City Public Service Board**	**263,012**	**26,710**	**87,147**	**41,195**	**100,614**	**7,992**	**3,315**	**3,030**
46	Equitable Gas	258,858	82,315	293,703	35,698	338,809	26,549	3,325	N/A
47	Washington Natural Gas Co.	244,322	623,000	292,174	6,885	274,320	23,287	5,805	5,651
48	Northwest Natural Gas Co.	236,849	72,415	335,610	13,714	324,678	30,638	7,674	4,400
49	Louisville Gas & Electric Co.	232,739	58,307	443,893^{E}	42,113	132,989	4,973	3,127	N/A
50	Louisiana Gas Service Co.	232,158	22,224	76,400	747	60,663	8,261	3,579	2,539
51	**Iowa Power & Light Co.**	**229,845**	**4,350**	**297,983**	**26,784**	**93,321**	**4,845**	**2,001**	**2,023**
52	**Memphis Light, Gas & Water**	**229,335**	**68,450**	**172,698**	**6,908**	**107,644**	**9,853**	**2,898**	**1,336**
53	**Iowa-Illinois Gas & Electric Co.**	**222,665**	**68,408**	**211,477**	**10,613**	**161,205**	**10,050**	**3,446**	**2,563**
54	**N.J. Natural Gas Co.**	**221,478**	**44,220**	**176,841**	**7,006**	**160,558**	**12,350**	**4,262**	**3,696**
55	**Bay State Gas Co.**	**217,485**	**40,871**	**209,613**	**8,775**	**209,609**	**—**	**3,717**	**N/A**
56	Rochester Gas & Electric Corp.	213,157	42,362	502,425^{E}	43,651	181,145	11,440	3,224	2,565
57	Mississippi Valley Gas Co.	212,939	57,436	170,867	4,833	91,252	4,267	4,295	N/A
58	Wisconsin Natural Gas Co.	212,282	75,850	259,519	5,323	140,322	14,139	4,148	2,785
59	Kansas-Nebraska Natural Gas	203,000	133,816	371,607	21,870	446,550	43,285	12,847	3,272
60	Citizens Gas & Coke Utility	202,975	53,178	144,693	1,582	216,423	32,305	3,182	4,111

The P&GJ 500 ... dimensions of the pipeline energy business

Rank	Name of Company	Number of Customers	1980 Gas Sales, MMcf	1980 Oper. Revenues $ (000)	1980 Net Income $ (000)	Gas plant value $ (000) 12-31-80	Additions to plant $ (000)	Miles of Mains	Miles of Services
61	UGI	197,426	61,250	234,717	17,671	220,920	26,124	3,241	1,988
62	Elizabethtown Gas	191,001	34,954	162,815	7,188	136,892	14,203	2,074	1,763
63	Piedmont Natural Gas Co., Inc.	190,682	65,073	222,171	9,275	190,738	17,483	5,036	N/A
64	South Jersey Gas Co.	189,000	3,472	150,819	12,527	136,242	22,659	—	—
65	Central Illinois Light Co.	183,477	48,453	394,821[E]	29,695	183,806	17,658	3,157	2,743
66	Peoples Gas System, Inc. (Tampa)[A]	182,500	41,600	138,000	4,000	93,000	7,000	—	—
67	New Orleans Public Service Inc.	176,500	27,600	79,680	14,760	71,873	2,751	1,423[A]	—
68	South Carolina Electric & Gas Co.	166,470	48,734	630,746[E]	63,700	143,712	6,051	4,230	3,472
69	Montana Dakota Utilities	165,000	44,430	118,676	6,143	252,998	21,000	2,992	N/A
70	Northeast Utilities	150,394	27,546	145,384	5,964	185,285	19,903	2,209	1,244
71	Wisconsin Public Service Corp.	149,913	50,900	436,400[E]	35,450	101,000	5,800	2,694	2,000
72	Central Illinois Public Serv. Co.	147,769	31,664	93,710	4,493	115,821	5,691	2,556	2,267
73	Commonwealth Gas Co.	146,373	322,921	145,865	5,357	75,612	7,907	1,751	1,234
74	Public Service Co. of NC, Inc.	142,227	43,942	159,226	4,667	108,336	16,180	3,292	N/A
75	Western Kentucky Gas Co.	134,655	39,793	107,003	2,571	76,464	N/A	3,127	N/A
76	Long Beach Gas Dept.	133,000	21,688	55,500	N/A	N/A	N/A	854	1,800
77	The Kansas Power & Light Co.	130,820	47,920	99,165	2,029	50,761	4,789	2,105	2,719
78	Southern Connecticut Gas Co.	130,061	19,432	106,595	6,067	91,772	5,066	1,763	1,984
79	Iowa Electric Light & Power Co.	130,055	38,453	313,619[E]	22,907	58,284	3,786	2,072	1,939
80	NYSEG	127,947	36,534	138,812	5,730	124,834	6,961	2,384	1,416
81	Metropolitan Utilities District Omaha, Nebr.	127,283	31,785	80,323	3,006	98,513	5,017	1,689	1,917
82	Iowa Public Service Co.	121,422	41,463	278,679	31,383	68,925	4,156	1,848	1,644
83	Virginia Electric & Power Co.	120,108	17,495	70,256	N/A	66,289	4,159	2,108	300
84	Providence Gas Co. & Subsidiaries	114,769	19,731	99,069	4,215	81,447	5,274	1,677	1,193
85	Connecticut Natural Gas Corp.[A]	114,608	22,808	84,609	N/A	N/A	N/A	1,535	N/A
86	Connecticut Light & Power Co.[A]	113,875	18,719	73,303	N/A	N/A	N/A	1,723	N/A
87	Gasco Incorporated[A]	111,700	52,100	38,313	N/A	N/A	N/A	N/A	N/A
88	Pennsylvania Gas & Water Co.	111,308	33,240	124,242	17,962	101,928	9,608	1,903	N/A
89	Cons. Gas Supply Corp.	111,298	67,468	1,708,937	28,851	580,659	15,908	8,100	2,613
90	Michigan Gas Utilities Co.	104,857	37,248	122,644	2,870	102,355	6,682	2,523	2,291
91	The Montana Power Co.	103,136	34,159	149,394	43,077	233,296	13,057	1,787	1,933
92	Wisconsin Power & Light Co.	100,141	27,944	103,373	N/A	86,176	7,524	2,104	258
93	North Shore Gas Co.	96,635	34,806	123,949	3,064	103,979	5,254	1,585	1,483
94	City Gas Co. of Florida	93,950	12,406	43,642	2,517	38,942	2,120	1,701	946
95	Intermountain Gas Co.	91,383	33,008	138,833	2,421	115,207	4,641	—	—
96	Orange & Rockland Utilities, Inc.	86,626	24,571	88,389	2,668	64,608	7,509	1,439	1,181
97	Colonial Gas Energy System	85,543	15,544	87,139	2,965	95,698	4,226	1,948	—
98	Gulf States Utilities Co.	85,218	9,097	31,014	672	16,723	1,196	1,280	1,153
99	Cascade Natural Gas Corp.	82,509	39,349	176,170	4,539	138,722	11,094	2,744	1,352
100	North Carolina Natural Gas Corp.	80,449	41,947	137,105	3,939	76,057	4,889	835	1,815
101	Colorado Spgs. Dept. of Publ. Util.	81,609	18,578	57,674	531	35,026	2,460	1,236	448
102	Washington Water Power Co.	75,752	83,637	132,584	29,582	77,975	2,426	2,140	N/A
103	Delmarva Power & Light Co.	73,042	15,693	520,470[E]	48,957	63,720	2,760	95	923
104	Arkansas Western Gas Co.[A]	70,666	17,107	43,063	1,542	51,660	5,258	1,824	290
105	Vangas, Inc.[A]	70,500	—	—	—	—	—	25	—

The P&GJ 500 ... dimensions of the pipeline energy business

Rank	Name of Company	Number of Customers	1980 Gas Sales, MMcf	1980 Oper. Revenues $ (000)	1980 Net Income $ (000)	Gas plant value $ (000) 12-31-80	Additions to plant $ (000)	Miles of Mains	Miles of Services
106	Madison Gas & Electric Co.	68,174	20,011	161,755[E]	15,548	58,422	5,490	1,243	916
107	City of Richmond, VA	68,058	12,962	45,966	911	42,515	4,008	960	N/A
108	Trans Louisiana Gas Co.	67,743	2,605	9,495	118	N/A	N/A	N/A	N/A
109	Nashville Gas Co.	67,227	20,082	60,772	519	48,445	1,955	1,394	N/A
110	Michigan Power Co.	65,883	22,896	71,591	967	41,567	3,243	1,498	N/A
111	**Rio Grande Valley Gas Co.**	**64,850**	**6,534**	**20,000[B]**	**N/A**	**N/A**	**N/A**	**1,074**	**194**
112	**Southeastern Michigan Gas Co.**	**64,500**	**15,427**	**51,453**	**2,054**	**65,305**	**2,731**	**1,408**	**968**
113	**Northwestern Public Service Co.**	**62,413**	**13,740**	**33,646**	**13,503**	**27,566**	**N/A**	**1,001[A]**	**—**
114	**Associated Natural Gas Co.**	**62,002**	**12,496**	**38,763**	**2,210**	**20,810**	**1,374**	**1,348[A]**	**N/A**
115	**Southern Indiana Gas & Elec. Co.**	**61,998**	**19,861**	**52,190**	**N/A**	**31,706**	**1,552**	**976**	**1,172**
116	Greeley Gas Co.[A]	61,080	16,867	34,074	—	—	—	—	—
117	Dixie Gas Co.[A]	61,000	500	1,500	—	—	—	12	150
118	United Cities Gas Co.	59,021	162,007	53,533	1,672	49,275	5,121	189	1,527
119	North Central Pub. Serv. Co.	57,963	32,400	144,998[E]	N/A	48,281	4,831	1,056[A]	—
120	City of Corpus Christi-Gas Div.	56,743	5,905	20,550	1,606	13,170	705	974	226
121	**West Ohio Gas Co.**	**54,106**	**13,190**	**46,951**	**1,063**	**30,794**	**1,545**	**1,161**	**260**
122	**City Utilities of Springfield, MO**	**53,243**	**11,558**	**59,212**	**2,220**	**26,179**	**1,384**	**765**	**767**
123	**Union Gas System Inc.**	**52,468**	**17,133**	**33,034**	**1,576**	**10,794**	**—**	**—**	**—**
124	**Arkansas Oklahoma Gas Corp.**	**52,353**	**12,933**	**27,723**	**360**	**32,278**	**2,509**	**167**	**399**
125	**Sierra Pacific Power Co.**	**52,258**	**7,106**	**233,943**	**22,089**	**29,671**	**3,276**	**589**	**403**
126	CP National Corp.	52,032	909	47,170	1,271	41,149	2,075	1,229	1,093
127	Commonwealth Gas Service Inc.[A]	49,525	11,866	38,216	—	—	—	940	—
128	Gas Light Co. of Columbus, GA	49,074	10,044	33,300	509	23,280	891	669	—
129	Lowell Gas Co.	48,915	11,199	54,336	2,514	60,348	3,450	859	N/A
130	Commonwealth Electric Co.	48,217	72,853	37,266	778	18,302	1,562	569	283
131	**Missouri Utilities**	**48,150**	**8,113**	**24,359**	**764**	**21,602**	**1,369**	**826**	**N/A**
132	**Pensacola Gas Division[A]**	**45,908**	**5,680**	**14,800**	**N/A**	**N/A**	**N/A**	**N/A**	**904**
133	**Valley Resources, Inc.**	**45,061**	**5,822**	**28,235**	**1,038**	**19,896**	**1,547**	**478**	**329**
134	**Central Hudson Gas & Electric Corp.**	**44,905**	**8,752**	**327,993[E]**	**23,898**	**53,551**	**3,031**	**689**	**436**
135	**Interstate Power Co.**	**44,316**	**24,970**	**62,159**	**2,677**	**24,057**	**2,065**	**808**	**N/A**
136	Missouri Public Service Co.	40,731	1,102	153,166[E]	12,459	25,009	887	860	486
137	Fall River Gas Co.	40,442	5,911	30,033	989	22,006	2,332	635	N/A
138	Alaska Gas & Service Co.	40,000	30,400	N/A	N/A	N/A	N/A	880	N/A
139	Florida Public Utilities	39,738	6,541	21,966	942	15,859	N/A	556	N/A
140	Cape Cod Gas Co.[A]	38,765	4,488	23,102	N/A	N/A	N/A	1,065	N/A
141	**Iowa Southern Utilities**	**37,864**	**10,052**	**102,126[E]**	**11,477**	**13,379**	**583**	**654**	**458**
142	**Wisconsin Fuel & Light Co.**	**36,920**	**15,192**	**49,062**	**758**	**12,099**	**1,595**	**845**	**550**
143	**Wisconsin Southern Gas Co.**	**36,442**	**8,314**	**28,985**	**863**	**24,248**	**1,306**	**977**	**606**
144	**Missouri Power & Light Co.[A]**	**34,918**	**7,897**	**20,443**	**N/A**	**N/A**	**N/A**	**677**	**442**
145	**Terre Haute Gas Corp.**	**32,380**	**16,695**	**43,623**	**N/A**	**N/A**	**N/A**	**693**	**330**
146	Southeast Alabama Gas District[A]	31,050	10,122	28,409	N/A	N/A	N/A	765	N/A
147	The Hartford Electric Light Co.[A]	30,813	4,627	17,072	N/A	N/A	N/A	394	N/A
148	Battle Creek Gas Co.	30,513	12,296	36,640	1,682	28,043	2,264	506	50
149	Roanoke Gas Co.	30,173	7,313	29,029	1,062	20,883	1,362	611	N/A
150	North Penn Gas Co.[A]	29,931	26,554	78,388	1,375	31,664	1,561	1,869	600

The P&GJ 500 ... dimensions of the pipeline energy business

Rank Name of Company	Number of Customers	1980 Gas Sales, MMcf	1980 Oper. Revenues $ (000)	1980 Net Income $ (000)	Gas plant value $ (000) 12-31-80	Additions to plant $ (000)	Miles of Mains	Miles of Services
151 Haverhill Gas Co.	28,773	4,367	21,851	856	23,214	2,261	560	N/A
152 City of Salem[A]	28,000	880	1,400	N/A	N/A	N/A	50	100
153 Penn Fuel Gas Inc.[A]	27,375	172,319	44,898	N/A	N/A	N/A	N/A	N/A
154 Kokomo Gas & Fuel Co.[A]	27,231	10,578	23,271	N/A	N/A	N/A	118	698
155 Portsmouth Gas Co.[A]	26,342	3,849	13,196	N/A	N/A	N/A	513	505
156 Huntsville Utilities[A]	25,793	5,487	13,533	N/A	N/A	N/A	27	523
157 Ohio Gas Co.	24,422	6,756	23,002	1,178	24,327	2,484	513	400
158 Alexandria Gas Department[A]	24,250	3,078	7,242	N/A	N/A	N/A	57	N/A
159 Chattanooga Gas Co.	28,381	24,081	68,098	679	36,619	1,718	822	N/A
160 Northern Utilities, Inc.[A]	24,071	3,900	14,842	N/A	N/A	N/A	644	N/A
161 Ohio Valley Gas Co.[A]	23,736	7,739	19,609	N/A	N/A	N/A	152	357
162 Berkshire Gas Co.[A]	23,614	4,400	14,637	N/A	N/A	N/A	560	N/A
163 Cheyenne Light, Fuel & Power	23,251	15,984	32,617	619	10,216	716	399	N/A
164 Hoosier Gas Corp.[A]	23,000	5,322	12,237	N/A	N/A	N/A	N/A	N/A
165 Palo Alto Municipal Gas Utility[C]	22,840	3,245	10,565	481	2,241	229	203	215
166 City of Mesa, Arizona	22,448	2,380	8,571	157	9,438	700	511	319
167 City of Hamilton, Ohio	22,056	4,971	13,565	(165)	4,374	(331)	209	648
168 Great Falls Gas Co.	22,043	5.4	18,552	411	9,394	315	267	N/A
169 Willmut Gas & Oil Co.	21,259	3,756	N/A	N/A	N/A	N/A	475	390
170 City of Duluth Department of Water and Gas	21,123	5,229	16,010	161	16,444	2,230	408	N/A
171 Delta Natural Gas Co. Inc.	20,487	3,767	17,593	357	15,735	1,482	493	N/A
172 City of Albany Water, Gas & Light Commission[A]	20,271	4,851	11,000	N/A	N/A	N/A	335	N/A
173 Nebraska Natural Gas Co.[A]	20,238	7,088	14,337	N/A	N/A	N/A	27	N/A
174 Rocky Mountain Natural Gas Co. Inc.	20,161	3,780	15,791	509	21,100	2,278	380	370
175 Gulf Natural Gas Corp.[A]	20,000	N/A	N/A	N/A	N/A	N/A	395	N/A
176 Brazos River Gas Co.	19,886	8,063	8,204	78	4,070	1,506	521	37
177 Austell Natural Gas System[A]	19,180	3,979	11,194	N/A	N/A	N/A	N/A	448
178 River Gas Company[A]	18,390	4,700	13,566	N/A	N/A	N/A	503	139
179 Knoxville Utilities Board	18,284	6,267	23,365	3,480	16,732	3,843	620	340
180 Okaloosa County Gas District[A]	17,500	2,446	8,048	N/A	N/A	N/A	343	461
181 Kansas Public Service Co.	18,075	3,903	9,704	318	5,747	N/A	258	N/A
182 Great River Gas Company	17,795	5,806	19,168	427	9,508	789	479	333
183 Inter-City Gas Corp.[A]	17,517	18,230	N/A	N/A	N/A	N/A	501	265
184 Union Electric Co.	17,290	3,130	11,509	675	13,154	682	258	N/A
185 Gas Service Inc. of New Hampshire[A]	16,726	3,044	10,051	N/A	N/A	N/A	341	N/A
186 South Coast Gas Company[A]	16,500	1,300	N/A	N/A	N/A	N/A	210	N/A
187 Northern Indiana Fuel & Light Co. Inc.[A]	15,914	5,351	11,592	N/A	N/A	N/A	50	386
188 Jackson Utility Division[A]	15,734	5,473	9,095	N/A	N/A	N/A	353	N/A
189 Citizens Utilities Co.	15,430	4,255	10,723	N/A	N/A	3,387	4,255	N/A
190 Manchester Gas Co.	15,277	1,800	2,331	504	15,074	2,482	191	9

The P&GJ 500 ... dimensions of the pipeline energy business

Rank	Name of Company	Number of Customers	1980 Gas Sales, MMcf	1980 Oper. Revenues $ (000)	1980 Net Income $ (000)	Gas plant value $ (000) 12-31-80	Additions to plant $ (000)	Miles of Mains	Miles of Services
191	Pennsylvania & Southern Gas Co.	14,851	5,600	19,532	641	14,476	242	454	141
192	Northern Gas Co.[A]	14,487	3,498	10,541	N/A	N/A	N/A	302	42
193	City of Danville Gas Department[C]	14,707	5,425	14,528	1,276	2,708	136	237	217
194	City of Trussville Utilities Board	14,638	1,771	8,341	1,256	16,601	119	300	N/A
195	Rio Grande Natural Gas Assoc.[A]	14,500	2,500	1,200	N/A	N/A	N/A	390	N/A
196	Fitchburg Gas & Electric Light Co.	14,280	2,894	42,310[E]	1,703	12,796	2,211	289	N/A
197	Valley Cities Gas Service[A]	14,083	4,013	11,693	N/A	N/A	N/A	456	N/A
198	Moran Utilities Co.	14,060	4,602	11,994	528	4,998	N/A	287	96
199	Carolina Energies Inc.[F]	14,000	34,452	105,448	6,555	45,365	1,632	414	N/A
200	Volunteer Natural Gas Co.[A]	13,213	8,500	22,000	N/A	N/A	N/A	559	N/A
201	Great Plains Natural Gas Co.	13,115	3,712	13,720	480	6,646	286	65	309
202	Richmond Gas Corp.[A]	13,009	3,631	9,166	N/A	N/A	N/A	209	140
203	City of Las Cruces[A]	12,506	1,778	4,000	N/A	N/A	N/A	50	51
204	Lancaster Municipal Gas Co.	12,398	2,253	1,012	6,829	N/A	N/A	281	N/A
205	City of Houma	12,200	3,846	4,788	433	1,078	100	10.5	173
206	Easley-Ft. Hill Gas Authority[A]	12,143	2,598	7,258	N/A	N/A	N/A	219	N/A
207	City of Warner Robbins[A]	11,789	5,643	6,858	N/A	N/A	N/A	18	190
208	Corning Natural Gas Corp.	11,623	13,171	12,343	318	7,265	239	312	N/A
209	City of Holyoke Gas & Electric Dept.[A]	11,150	1,683	5,496	N/A	N/A	N/A	124	N/A
210	Vermont Gas Systems Inc.[A]	11,139	4,049	13,150	N/A	N/A	N/A	186	N/A
211	Dalton Utilities[A]	10,703	9,617	3,108	N/A	N/A	N/A	264	N/A
212	Hobbs Gas Co.[A]	10,673	1,512	4,074	N/A	N/A	N/A	25	242
213	Charlottesville Gas Division[A]	10,600	2,500	N/A	N/A	N/A	N/A	23	156
214	Pavilion Natural Gas Co.[A]	10,002	2,782	6,686	N/A	N/A	N/A	174	83
215	Middle Tennessee Natural Gas Utility District[A]	9,972	2,880	9,588	N/A	N/A	N/A	599	300
216	Citizens Gas Fuel Co.	9,920	2,909	11,129	806	10,368	781	216	N/A
217	Lake Superior District Power Co.	9,793	10,278	44,658	1,791	6,845	434	228	N/A
218	Union Gas Co.[A]	9,751	5,260	14,261	N/A	N/A	N/A	325	N/A
219	Hastings Utilities	9,628	1,853	4,772	188	4,572	579	140	N/A
220	Southern Public Service Co.[A]	9,590	1,639	3,756	N/A	N/A	N/A	230	N/A
221	Community Public Service Co.[A]	9,362	1,135	2,953	N/A	N/A	N/A	237	N/A
222	Austin Utilities	9,255	8,359	8,379	244	1,502	147	141	N/A
223	City of Florence Gas Dept.	9,164	1,524	4,430	105	5,054	427	410	200
224	Lynchburg Gas Co.	9,158	4,941	16,812	523	11,238	1,652	320	175
225	Midwest Energy Inc.	9,080	2,476	5,107	77	3,564	166	158	N/A
226	City of Pleasant Grove Utilities	9,035	890	4,483	707	500	—	178	85
227	Northern Utilities Co., Allied Div.[A]	9,007	1,960	6,637	N/A	N/A	N/A	249	N/A
228	Superior Water, Light & Power Co.	8,904	257,939	7,890	234	6,419	320	154	134
229	Cedar Falls Utilities	8,840	1,569	4,850	424	3,269	—	127	72
230	Greenwood Comm. of Public Works[A]	8,623	3,111	6,012	N/A	N/A	N/A	83	185
231	Vicksburg Water & Gas Admin.	8,373	1,175	5,248	813	1,800	475	112	—
232	North Carolina Gas Service[A]	8,333	1,750	5,144	N/A	N/A	N/A	295	—
233	Rocky Mount, N.C.	8,195	2,170	8,562	2,069	1,420	142	78	90
234	Midwest Natural Gas Corp.[A]	7,783	1,898	3,478	N/A	N/A	N/A	89	118
235	City of LaGrange Gas Dept.[A]	7,758	2,000	2,500	N/A	N/A	N/A	100	N/A

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Rank	Name of Company	Number of Customers	1980 Gas Sales, MMcf	1980 Oper. Revenues $ (000)	1980 Net Income $ (000)	Gas plant value $ (000) 12-31-80	Additions to plant $ (000)	Miles of Mains	Miles of Services
236	Orangeburg Dept. of Public Utilities	7,413	3,408	10,265	729	2,535	55	196	8,549
237	Norwich Dept. of Public Utilities	7,210	997	4,231	(422)	5,197	239	106	—
238	Tallahassee Gas Division[A]	7,190	1,409	3,961	N/A	N/A	N/A	N/A	233
239	Clinton-Newberry Nat'l. Gas Auth.[A]	7,170	N/A	4,035	N/A	N/A	N/A	105	400
240	Owatonna Public Utilities	7,021	3,174	7,410	697	2,258	108	115	N/A
241	**City of Graysville, Ala.**	**7,000**	**610**	**2,851**	**334**	**3,215**	**N/A**	**140**	**30**
242	**Schagrin Gas Company[A]**	**7,000**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
243	**Houston-Magnolia Park Gas System[A]**	**6,927**	**N/A**	**1,408**	**N/A**	**N/A**	**N/A**	**N/A**	**55**
244	**Dyersburg Gas Dept.[A]**	**6,837**	**1,632**	**2,941**	**N/A**	**N/A**	**N/A**	**N/A**	**228**
245	**City of Del Rio Gas System**	**6,819**	**480**	**1,671**	**23**	**N/A**	**N/A**	**157**	**N/A**
246	Phoenix City Utilities, Gas Dept.[A]	6,651	1,393	1,086	N/A	N/A	N/A	140	N/A
247	Westfield Gas & Electric Light Dept.	6,235	892	4,287	220	1,678	158	121	66
248	Norco Gas & Fuel Co., Inc.	6,222	946	3,679	41	1,790	52	139	31
249	Dixie Gas Co., Inc.	6,219	521	2,073	24	1,825	95	181	29
250	Liberal Gas Company[A]	6,200	1.3	2,000	N/A	N/A	N/A	105	N/A
251	**Missouri Edison Co.**	**6,099**	**3,551**	**44,072[E]**	**1,771**	**5,985**	**161**	**302**	**144**
252	**Gibson County Utility District[A]**	**6,052**	**1.06**	**N/A**	**N/A**	**N/A**	**N/A**	**128**	**175**
253	**City of Wilson, N.C.[A]**	**5,964**	**864**	**2,641**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
254	**Fultondale Gas Co.[A]**	**5,957**	**638**	**2,352**	**N/A**	**N/A**	**N/A**	**N/A**	**143**
255	**Gas Utilities Co.[A]**	**5,938**	**5,249**	**6,831**	**N/A**	**N/A**	**N/A**	**146**	**N/A**
256	Allied Gas Co.[A]	5,895	2,261	6,386	N/A	N/A	N/A	N/A	N/A
257	Consumers Gas Utility Co.[A]	5,894	1,126	3,311	N/A	N/A	N/A	127	25
258	Lake Apopka Nat. Gas District[A]	5,862	1,203	2,875	N/A	N/A	N/A	273	N/A
259	Concord Natural Gas Corp.	5,684	1,070	4,752	206	4,871	373	146	78
260	Cullman-Jefferson Counties Gas Dist.[A]	5,573	1,680	4,067	N/A	N/A	N/A	60	350
261	**The Polaris Corp.[A]**	**5,516[A]**	**518**	**1,314**	**N/A**	**N/A**	**N/A**	**106**	**68**
262	**Cartersville Gas Dept.[A]**	**5,508**	**2,250**	**1,856**	**N/A**	**N/A**	**N/A**	**N/A**	**163**
263	**Bay City Gas Co., Tex.[A]**	**5,423**	**N/A**	**600**	**N/A**	**N/A**	**N/A**	**N/A**	**108**
264	**Elizabethtown Gas Dept.**	**5,296**	**1,368**	**3,376**	**3,683**	**1,000**	**—**	**30**	**126**
265	**Consumers Gas Co.**	**5,262**	**1,396**	**2.790**	**N/A**	**N/A**	**N/A**	**88**	**70**
266	Shenandoah Gas Co.[A]	5,224	4,267	10,816	N/A	N/A	N/A	135	76
267	City of Moss Point Utilities	5,200	352	478	N/A	N/A	N/A	N/A	N/A
268	City of Thibodaux Gas Dept.	5,185	667	2,599	45	487	N/A	80	N/A
269	Carnegie Natural Gas Co.	5,152	26,085	64,372	3,035	25,646	5,584	256	N/A
270	The Toledo Edison Co.	5,136	1,417	4,182	282	4,997	338	105	94
271	**Natural Gas Distributing Co.[A]**	**5,058**	**968**	**2,000**	**N/A**	**N/A**	**N/A**	**92**	**16**
272	**Watertown Gas Dept.[A]**	**5,013**	**1,083**	**1,996**	**N/A**	**N/A**	**N/A**	**108**	**N/A**
273	**City of Milton Natural Gas System[A]**	**5,000**	**450**	**1,200**	**N/A**	**N/A**	**N/A**	**43**	**N/A**
274	**Sylacauga Utilities Board[A]**	**4,948**	**1,390**	**3,581**	**N/A**	**N/A**	**N/A**	**472**	**N/A**
275	**South Penn Gas Co.[A]**	**4,929**	**2,529**	**6,929**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
276	New Ulm Public Utilities	4,882	1,017	4,630	81	1,736	65	71	N/A
277	Decatur Utilities Gas Dept.	4,842	5,546	16,568	600	6,182	2,014	162	84
278	Northwest Alabama Gas District	4,837	5,027	15,063	1,553	13,977	36	380	270
279	Chanute Municipal Gas Dept.[A]	4,822	1,032	1,974	N/A	N/A	N/A	107	N/A
280	City of Leesburg Natural Gas Dept.[A]	4,812	697	1,317	N/A	N/A	N/A	9	61

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281	Bristol and Warren Gas Co.[A]	4,794	484	2,005	N/A	N/A	N/A	69	N/A
282	Pike Natural Gas Co.[A]	4,750	1,038	2,967	N/A	N/A	N/A	52	N/A
283	St. Joseph Light & Power Co.[A]	4,667	1,321	3,867	N/A	N/A	N/A	121	52
284	Eastern Illinois Gas & Securities Co.[A]	4,626	1,102	N/A	N/A	N/A	N/A	23	132
285	Oak Ridge Utility District[A]	4,594	822	1,750	N/A	N/A	N/A	128	N/A
286	Thomasville Water & Light Dept.[A]	4,578	801	2,243	N/A	N/A	N/A	141	N/A
287	City of Fairhope Gas Dept.[A]	4,781	482	1,156	N/A	N/A	N/A	85	177
288	Illinois Gas Co.[A]	4,593	813	1,223	N/A	N/A	N/A	10	115
289	City of Lexington Natural Gas Dept.[A]	4,516	1,917	2,857	N/A	N/A	N/A	167	N/A
290	City of Winfield Gas Dept.[A]	4,500	87	1,855	N/A	N/A	N/A	13	N/A
291	Petrolane Wyoming Gas Service[A]	4,454	925	N/A	N/A	N/A	N/A	87	N/A
292	Clarksville Gas Department	4,380	2,826	6,777	283	3,680	63	210	104
293	Town of Westlake[C]	4,376	293	1,234	193	905	42	84	45
294	Indiana Natural Gas Corp.	4,240	909	2,998	175	2,250	114	145	N/A
295	West Tennessee Public Utility District	4,232	1,829	4,935	223	2,890	253	313	85
296	City of Dumas[A]	4,200	N/A	N/A	N/A	N/A	N/A	5	71
297	Cody Gas Co.	4,117	1,571	3,264	24	4,182	645	297	N/A
298	Syracuse Suburban Gas Co. Inc.	4,072	4,308	15,339	106	3,601	278	79	N/A
299	Bluefield Gas Co.	4,100[B]	1,192	4,050	104	2,029	71	98	39
300	Borough of Chambersburg Gas Dept.	4,043	1,003	2,875	249	1,887	94	52	32

The 100 Leading Gas Transmission Lines

Rank	Name of Company	Miles of Pipelines				1980 Gas Sales, MMcf	1980 Oper. Revenues $(000)	1980 Net Income, $(000)	Gas Plant Value (000) 12-31-8.	Additions to plant 1980 $(000)
		Total	Transmission	Field, Gath.	Storage					
1	InterNorth, Inc.	26,663	18,437	8,024	201	755,302	1,739,805	211,721	2,136,191	238,122
2	El Paso Natural Gas Co.	20,837	9,418	11,395	24	1,181,133	2,932,4[illegible]9	(33,896)	2,484,088	106,412
3	Columbia Gas Transmission Corp.	17,987	9,975	6,805	1,208	1,068,265	2,822,340	76,089	1,547,735	138,697
4	Tenneco, Inc.	13,579	13,546	31	2	1,113,322	2,552,637	725,572	2,584,726	121,612
5	Natural Gas Pipeline Co. of America	12,201	10,380	1,726	96	946,109	2,301,033	99,203	1,837,474	106,348
6	Panhandle Eastern Pipe Line Co.	11,857	6,766	4,983	109	664,987	1,515,496	180,237	1,153,115	102,352
7	Kansas-Nebraska Natural Gas Company, Inc.	11,655	9,152	2,482	21	100,761	205,850	21,870	330,157	35,318
8	Enserch Corp.	11,480	8,915	2,489	76	542,950	1,435,278	150,163	763,017	56,985
9	Pioneer Corp.	11,118	9,914	1,204	—	247,358	911,989	90,556	278,901	7,921
10	Michigan Wisconsin Pipe Line Co.	10,968	7,662	3,128	178	674,855	1,951,105	108,672	2,014,986	232,207
11	Transcontinental Gas Pipe Line Corp.	9,687	9,442	124	120	890,583	2,536,088	111,370	2,180,980	144,553
12	Cities Service Gas Co.	9,512	5,832	3,498	182	376,099	731,691	35,608	517,484	37,356
13	Texas-Eastern Transmission Corp.	9,268	9,030	48	190	931,250	2,068,579	243,667	1,879,325	45,933
14	United Gas Pipe Line Co.	9,161	7,308	1,825	28	1,020,879	2,462,826	87,981	852,842	83,229
15	Arkansas Louisiana Gas Co.	9,028	6,121	2,871	35	338,874	801,897	73,426	897,825	83,181
16	Consolidated Gas Supply Corp.	8,171	3,598	4,054	519	627,835	1,708,937	28,851	933,380	48,747
17	Southern Natural Gas Co.	7,296	7,097	150	48	596,886	1,407,447	[illegible]	961,237	93,947
18	Colorado Interstate Gas Co.	5,951	2,726	2,992	233	366,438	869,075	51,423	609,177	53,428
19	Texas Gas Transmission Corp.	5,888	5,610	61	217	633,133	1,353,725	78,553	746,821	41,393
20	Northwest Pipeline Corp.	5,352	3,096	2,249	7	332,012	1,294,622	55,452	766,844	80,428
21	ONEOK, Inc.	4,869	3,653	1,195	21	359,796	860,054	40,279	507,252	65,206
22	Trunkline Gas Co.	4,793	3,887	440	465	485,053	1,100,197	61,291	839,054	97,406
23	Pacific Gas & Electric Co.	4,765	3,847	867	51	761,856	2,954,715	135,867	2,219,386	135,832
24	Florida Gas Transmission Co.	4,280	4,280	—	—	183,544	464,842	26,973	412,931	11,320
25	Columbia Gulf Transmission Co.	3,965	3,965	—	—	1,410,448[A]	161,929	33,120	894,837	52,631

Footnotes: A. 1979 Data B. Estimated C. Transports gas for others; no sales.

The P&GJ 500 ... dimensions of the pipeline energy business

Rank	Name of Company	Miles of Pipelines				1980 Gas Sales, MMcf	1980 Revenues $(000)	1980 Net Income, $(000)	Gas Plant Value (000) 12-31-80	Additions to plant 1980 $(000)
		Total	Trans-mission	Field, Gath.	Storage					
26	Transwestern Pipeline Co.	3,679	3,679	—	—	305,325	719,574	23,143	467,170	24,149
27	National Fuel Gas Supply Corp.	3,617	1,504	1,674	440	201,500	542,113	14,232	172,429	15,743
28	The Montana Power Co.	3,168	1,826	1,288	54	49,827	342,459	43,077	233,296	13,057
29	Montana Dakota Utilities Co.	2,991	—	—	—	55,000[B]	181,591	27,077	—	—
30	Peoples Natural Gas Co.	2,329[A]	1,069	1,222	38	—	—	—	—	—
31	**Michigan Consolidated Gas Co.**	**2,312**	**2,178**	**28**	**106**	**426,851**	**1,414,787**	**14,863**	**1,342,445**	**74,461**
32	**Mitchell Energy & Development Corp.**	**2,160**	—	—	—	**83,647**	**696,044**	**100,835**	**75,122**	**27,681**
33	**Mississippi River Trans. Corp.**	**2,102**	**1,969**	**161**	**72**	**199,940**	**523,327**	**34,979**	**270,705**	**14,045**
34	**Equitable Gas Co.**	**2,088**	**473**	**1,488**	**128**	**93,545**	**293,705**	**35,698**	**370,489**	**25,661**
35	**Kentucky West Virginia Gas Co.**	**1,985**	**27**	**1,958**	—	**26,662**	**44,998**	**24,363**	**137,510**	**6,492**
36	Western Slope Gas Co.	1,976	1,549	400	27	57,657	144,514	2,378	82,267	22,290
37	Transok Pipeline Co.	1,878	756	1,122	—	92,777	126,564	5,082	59,587	10,281
38	Louisiana Intrastate Gas Corp.	1,820	1,820	—	—	208,242	658,441	38,784	211,576	59,874
39	Mountain Fuel Resources, Inc.	1,764	1,424	331	9	122,410	311,718	30,851	495,967	61,516
40	Southwest Gas Corp.	1,571	1,566	5	—	98,455	317,548	8,861	283,505	48,157
41	**National Fuel Gas Distribution**	**1,517**	**1,183**	**334**	—	**201,794**	**731,190**	**10,188**	**407,150**	**34,169**
42	**Central Illinois Public Service Co.**	**1,383**	**1,356**	**14**	**13**	**31,664**	**93,710**	**4,493**	**115,821**	**5,691**
43	**Consumers Power Company**	**1,244**	**1,115**	**22**	**107**	**340,762**	**986,350**	**65,427**	**1,195,295**	**61,429**
44	**Great Lakes Transmission Co.**	**1,241**	—	—	—	**78,497**	**497,519**	**16,892**	**421 524**	**28,846**
45	**Carnegie Natural Gas Co.**	**1,167**	**256**	**911**	—	**26,161**	**64,372**	**3,035**	**25,646**	**5,584**
46	National Gas & Oil Corp.	1,013	—	1,005	8	14,351	40,627	3,236	21,431	2,463
47	East Tennessee Natural Gas Co.	1,012	1,012	—	—	81,609	196,226	7,158	72,156	2,039
48	Carolina Energies, Inc.	1,000	1,000	—	—	34,452	105,448	6,555	44,841	1,090
49	North Penn Gas Co.	918	607	298	13	26,554	78,388	1,375	31,664	1,561
50	Midwestern Gas Transmission Co.	915	903	—	12	194,992	1,053,178	11,733	158,757	15,728
51	**Arkansas Western Gas Co.**	**911**	**682**	**225**	**4**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
52	**Algonquin Gas Transmission Co.**	**908**	**908**	—	—	**157,573**	**504,173**	**15,602**	**174,868**	**1,168**
53	**Mid Louisiana Gas Co.**	**776**	**392**	**384**	—	**31,245**	**83,030**	**6,719**	**55,037**	**10,890**
54	**South Georgia Natural Gas Co.**	**767**	**767**	—	—	**33,499**	**95,725**	**9,081**	**18,388**	**519**
55	**Michigan Gas Storage Co.**	**717**	**566**	**151**	—	**75,815**	**155,169**	**1,742**	**51,524**	**773**
56	Pacific Gas Transmission Co.	637	637	—	—	308,702	1,405,274	11,767	194,247	4,695
57	Associated Natural Gas	602	602	—	—	12,496	38,763	2,210	33,730	1,061
58	Arkansas Oklahoma Gas Corp.	566	394	169	3	12,933	27,723	360	32,278	2,509
59	Valero Transmission Co.	551	320	231	—	21,207	29,402	882,056	20,220	1,316
60	Inland Gas Co., Inc.	530	95	435	—	9,722	22,622	1,427	23,217	1,300
61	**Northern Utilities, Inc.**	**517**	**471**	**46**	—	**10,647**	**32,775**	**210**	—	—
62	**Ohio Valley Gas Corp.**	**482**	**152**	**330**	—	**6,458**	**19,006**	**506**	**11,748**	**925**
63	**Tejas Gas Corp.**	**460**	—	—	—	**85,000**	**57,300**	**4,100**	**27,408**	**6,000**
64	**Sea Robin Pipeline Co.**	**427**	**427**	—	—	**273,725**	**516,051**	**18,882**	**226,371**	**2,402**
65	**Washington Gas Light Co.**	**368**	**368**	—	—	**103,051**	**440,115**	**18,069**	**558,338**	**49,953**
66	MGTC, Inc.	360	353	7	—	4,428	9,872	763	4,500	300
67	Stingray Pipeline Co.	319	319	—	—	—	46,774	9,227	233,607	267
68	Alabama-Tennessee Natural Gas	314	313	1	—	35,522	91,919	5,265	17,035	572
69	Louisville Gas & Electric Co.	306	178	—	128	58,307	443,893	42,113	132,989	4,973
70	Northern Gas Co.	300	241	47	12	614	17,447	87,447	4,066	848

The P&GJ 500 ... dimensions of the pipeline energy business

Rank Name of Company	Miles of Pipelines Total	Transmission	Field, Gath.	Storage	1980 Gas Sales, MMcf	1980 Revenues $(000)	1980 Net Income, $(000)	Gas Plant Value (000) 12-31-80	Additions to plant 1980 $(000)
71 Ringwood Gathering Co.	272	26	246	—	10,694	14,225	330	9,322	1,562
72 Western Gas Interstate Co.	251	229	22	—	5,330	11,203	287	3,808	571
73 Delta Natural Gas Co., Inc.	247	174	67	6	4,583	17,593	357	10,717	1,199
74 South Jersey Gas Co.	242	239	—	3	41,988	177,605	9,644	138,047	14,768
75 Eastern Shore Natural Gas Co.	238	238	—	—	8,575	30,097	1,601	7,144	50
76 St. Lawrence Gas	234	234	—	—	6,342	31,393	228	10,993	366
77 Valley Gas Transmission Inc.	229	—	229	—	4,330	5,688	94	3,950	66
78 Alaska Pipeline Co.	218	211	7	—	30,460	N/A	N/A	N/A	N/A
79 High Island Offshore System	203	203	—	—	563,589	134,652	11,277	339,510	2,291
80 Consolidated Systems LNG Co.	200	200	—	—	21,659	128,436	13,418	268,623	2,148
81 Standard Pacific Gas Line Inc.	190	185	5	—	—	N/A	N/A	22,639	890
82 McCulloch Interstate Gas Corp.	185	185	—	—	4,448	9,7[illegible]	602	9,299	38
83 Peoples Natural Gas Co. of S.C.	183	183	—	—	—	9,[illegible]	321	5,210	681
84 Sabine Pipe Line Co.	174	174	—	—	—	1,[illegible]6	204	19,115	7
85 Chandeleur Pipe Line Co.	161	161	—	—	—	1,200	(222)	15,984	—
86 San Diego Gas & Electric	128	128	—	—	88,483	299,036	16,563	154,297	18,930
87 West Texas Gathering Co.	127	59	68	—	38,269	35,340	64	4,338	19
88 Gas Transport, Inc.	109	41	68	—	3,799	10,669	868	3,629	164
89 Columbia LNG Co.	88	88	—	—	25,713	124,418	12,164	202,447	3,875
90 Boettcher Oil & Gas. Co.	122	122	—	—	N/A	N/A	N/A	N/A	N/A
91 Lone Star Gathering Co.	84	77	7	—	15,808[A,C]	383	85	2,382	4,829
92 Shenandoah Gas Co.	79	79	—	—	4,152	13,797	171	9,860	1,216
93 Louisiana-Nevada Transit Co.	78	78	—	—	3,992	3,355	181	1,899	119
94 Inter-City Minnesota Pipelines Ltd.	65	65	—	—	12,192	43,063	246	2,679	—
95 Great Plains Natural Gas Co.	65	65	—	—	3,712	13,720	480	10,422	776
96 Granite State Gas Transmission Inc.	57	57	—	—	4,530	12,638	157	2,913	73
97 Tennessee Natural Gas Lines Inc.	56	56	—	—	28,324	63,785	2,472	10,221	107
98 Black Marlin Pipeline Co.	54	54	—	—	2,737	160,823	—	6,753	—
99 Pennsylvania & Southern Gas Co.	50	50	—	—	—	19,533	641	13,422	757
100 Midwest Energy, Inc.	50	50	—	—	2,476	5,107	77	3,564	166

The 100 Leading Liquid Pipelines

Rank Name of Company	Bbl (000) delivered out of system Crude oil	Products	Total	1980 Financial (000) Oper Rev.	Net Income	Property Value (000) 12-31-80	Changes in Prop. Val., $(000)	Miles of Lines Owned/Operated Gath. Lines	Crude Trunk	Products Trunk	Total
1 Arco Pipeline Company	520,105	145,281	665,386	833,733	241,419	2,380,512	87,278	1,810	2,669	3,729	8,208
2 Colonial Pipeline Company	—	632,497	632,497	338,353	73,521	1,261,058	140,633	—	—	5,194	5,194
3 Exxon Pipe Line Company	497,235	65,128	562,363	790,968	263,025	2,167,907	58,917	1,892	4,936	2,235	9,063
4 Shell Pipe Line Company	393,904	125,664	519,569	119,890	23,598	40,392	29,622	2,211	5,239	378	7,828
5 Amoco Pipe Line Company	387,187	128,536	515,724	143,425	45,901	463,005	33,757	2,312	8,315	1,667	12,294
6 Marathon Pipe Line Company	320,567	183,966	504,533	84,485		310,066	23,072	1,026	1,537	1,379	3,942
7 Gulf Refining Company	260,216	233,192	483,416	69,996	20,300	237,592	23,556	1,970	1,161	2,039	5,170
8 Texas Pipe Line Company	314,716	161,368	476,084	74,984	17,833	244,310	6,274	1,248	2,490	539	4,277
9 Lakehead Pipe Line Company	461,018	—	461,018	136,709	26,666	441,766	6,206	—	2,601	—	2,601
10 Mobil Pipe Line Company	256,388	102,140	358,528	118,396	40,694	273,833	6,170	4,368	5,118	2,297	11,783

The P&GJ 500 ... dimensions of the pipeline energy business

Rank	Name of Company	Bbl (000) delivered out of system			1980 Financial (000)		Property Value (000) 12-31-80	Changes in Prop. Val., $(000)	Miles of Lines Owned/Operated			
		Crude oil	Products	Total	Oper Rev.	Net Income			Gath. Lines	Crude Trunk	Products Trunk	Total
11	Sohio Pipe Line Company	269,771	42,790	312,561	1,151,533	413,238	3,256,762	43,168	49	262	81	392
12	Buckeye Pipe Line Company	9,246	251,524	260,770	81,438	31,848	319,260	19,943	—	132	3,340	3,472
13	Phillips Pipe Line Company	77,735	151,144	228,880	74,329	10,477	320,235	70,411	1,099	1,947	2,886	5,932
14	Southern Pacific Pipe Lines, Inc.	—	227,338	227,338	57,991	19,014	139,336	13,468	—	—	2,511	2,511
15	Sun Pipe Line Company	122,754	88,202	210,957	50,890	16,305	134,346	7,641	936	1,423	1,881	4,267
16	Continental Pipe Line Company	136,560	51,552	188,112	50,355	16,314	144,357	6,712	4,203	1,491	1,795	7,489
17	Plantation Pipe Line Company	—	182,250	182,250	78,939	11,018	282,555	1,082	—	—	3,154	3,154
18	Williams Pipe Line Company	15,015	161,203	176,218	132,846	26,451	448,073	11,565	—	82	8,191	8,273
19	Chevron Pipe Line Company	123,749	36,097	159,846	42,363	7,383	161,160	14,981	214	1,437	1,490	3,141
20	Texas-New Mexico Pipe Line Co.	152,596	—	152,596	26,822	5,993	86,141	1,421	1,916	2,226	—	4,142
21	Cities Service Pipe Line Company	139,485	4,281	143,766	18,725	2,251	57,252	1,562	626	876	110	1,621
22	Mid-Valley Pipe Line Company	143,376	—	143,376	40,920	5,232	113,130	1,476	—	1,099	—	1,099
23	MAPCO (Mid-America Pipe Line)	—	131,346	131,346	66,792	26,986	361,239	112,696	—	—	7,606	7,606
24	Chicap Pipe Line Company	119,406	—	119,406	12,494	2,427	38,319	538	—	235	—	235
25	Texas Eastern Products Pipeline	—	118,768	118,768	77,855	—	384,695	30,323	—	—	3,333	3,333
26	Ashland Pipe Line Company	106,376	—	106,376	36,807	12,372	90,141	1,682	453	859	—	1,312
27	West Texas Gulf Pipe Line Co.	102,337	—	102,337	16,162	4,043	44,586	35	—	582	—	582
28	Texoma Pipe Line Company	98,290	—	98,290	39,321	7,234	135,752	714	—	504	—	504
29	Four Corners Pipe Line Co.	82,622	13,436	96,058	32,355	9,641	94,393	11,831	295	1,115	24	1,434
30	Texaco-Cities Service Pipe Line Co.	89,798	3,010	92,808	12,804	1,804	51,299	852	—	1,772	106	1,878
31	BP Pipelines, Inc.	87,319	—	87,319	556,820	232,645	1,581,617	82,794	—	818	—	818
32	Wolverine Pipe Line Co.	—	86,292	86,292	23,045	4,150	N/A	N/A	—	—	620	620
33	Explorer Pipe Line Co.	2,261	82,647	84,908	38,504	(1,293)	248,551	1,108	—	—	1,397	1,397
34	Pure Transportation Co.	61,743	19,053	80,796	13,734	2,468	57,011	142	572	433	12	1,017
35	Olympic Pipeline Co.	—	74,074	74,074	18,817	5,180	56,337	355	—	—	391	391
36	Southcap Pipe Line Co.	71,088	—	71,088	16,658	2,460	53,069	(1,960)	N/A	N/A	N/A	N/A
37	Lake Charles Pipe Line Co.	—	70,485	70,485	1,710	41	9,791	1,956	—	—	13	13
38	Owensboro-Ashland Co.	69,169	—	69,169	11,102	3,383	43,338	1,351	—	295	—	295
39	Badger Pipe Line Co.	—	58,660	58,660	7,901	996	22,993	715	—	—	328	382
40	Amdel Pipeline Inc.	52,069	11,501	63,571	6,946	5,603	19,316	—	10	529	28	567
41	Portland Pipe Line Co.	51,614	—	51,614	16,779	3,553	52,752	104	—	513	—	513
42	West Shore Pipe Line Co.	—	50,198	50,198	10,133	1,838	32,215	42	—	—	325	325
43	Hess Pipeline Co.	48,390	—	48,390	10,377	1,338	35,608	1,521	—	334	—	334
44	Seaway Pipeline Co.	48,186	—	48,186	18,155	(12,635)	208,909	7,041	—	515	—	515
45	Osage Pipe Line Co.	46,492	—	46,492	5,451	689	19,585	(10)	—	136	—	136
46	Tecumseh Pipe Line Co.	45,830	—	45,830	2,807	679	15,161	15	—	206	—	206
47	Platte Pipe Line Co.	43,679	—	43,679	15,253	2,496	69,838	110	—	1,280	—	1,280
48	Santa Fe Pipeline Co.	—	40,089	40,089	31,042	5,252	47,489	—	—	—	899	899
49	Oiltanking of Texas Pipeline Co.	37,214	—	37,214	2,791	385	8,579	—	—	15	—	15
50	Shamrock Pipe Line Corp.	24,643	12,031	36,674	14,658	5,054	16,859	1,354	628	316	544	1,588
51	Kaneb Pipe Line Company	—	35,859	35,859	18,637	2,496	44,651	—	—	—	1,303	1,303
52	Dome Pipeline Corporation	—	35,577	35,577	6,386	1,623	21,689	—	1	8	129	138
53	Minnesota Pipe Line Company	34,900	—	34,900	8,382	1,473	28,566	—	—	365	—	365
54	Laurel Pipe Line Company	—	34,673	34,673	12,605	2,612	56,115	504	—	—	452	452
55	Dixie Pipe Line Company	—	33,498	33,498	24,316	2,976	70,341	1,111	—	—	1,304	1,304

The P&GJ 500 ... dimensions of the pipeline energy business

Rank	Name of Company	Bbl (000) delivered out of system			1980 Financial (000)		Property Value (000) 12-31-80	Changes in Prop. Val., $(000)	Miles of Lines Owned/Operated			
		Crude oil	Products	Total	Oper Rev.	Net Income			Gath. Lines	Crude Trunk	Products Trunk	Total
56	Hydrocarbon Transportation, Inc.	—	33,038	33,038	33,689	9,038	124,661	—	—	—	1,514	1,514
57	Collins Pipe Line Company	—	31,832	31,832	3,342	N/A	14,292	—	—	—	124	124
58	Butte Pipe Line Company	31,055	—	31,055	8,729	1,834	17,491	104	—	373	—	373
59	Belle Fourche Pipe Line Company	29,836	—	29,836	12,990	N/A	43,770	2,045	895	728	42	1,666
60	Cook Inlet Pipe Line Company	27,904	—	27,904	10,555	2,810	42,351	21	—	55	—	55
61	Jayhawk Pipeline Corp.	27,885	—	27,885	4,042	274	20,018	178	230	513	—	743
62	Getty Pipeline Inc.	17,042	9,857	26,899	4,542	1,741	14,559	10,820	—	29	345	374
63	Wesco Pipe Line Co.	26,891	—	26,891	10,812	3,296	33,632	7,768	604	527	—	1,131
64	Mobil Alaska Pipeline Co.	26,428	—	26,428	167,224	65,988	390,766	(70,703)	—	818	—	818
65	Cochin Pipeline System	—	26,422	26,422	56,970	41,130	239,415	—	—	—	1,200	1,200
66	Total Pipeline Co.	19,391	7,009	26,400	7,762	2,049	22,185	9,577	—	275	64	339
67	CRA Inc.	24,404	—	24,404	2,549	655	10,418	258	646	242	—	888
68	American Petrofina Pipe Line Co.	23,264	1,078	24,343	340	41	10,866	20	161	538	46	745
69	Ohio River Pipeline Co.	—	23,112	23,112	2,128	380	5,258	484	—	—	364	364
70	Calnev Pipe Line Co.	—	22,736	22,736	10,013	4,595	25,582	2,812	—	—	423	423
71	Yellowstone Pipe Line Co.	—	20,340	20,340	6,787	1,205	27,826	82	—	—	751	751
72	Kenai Pipe Line Co.	19,825	—	19,825	3,827	673	13,097	51	—	24	—	24
73	Chase Transportation Co.	—	18,550	18,550	9,118	7,415	38,719	—	—	—	697	697
74	Wyco Pipe Line Co.	—	18,502	18,502	8,541	1,780	23,197	610	—	—	677	677
75	Diamond Shamrock Corp.	—	17,120	17,120	7,745	1,368	27,002	5,239	—	—	622	622
76	Portal Pipe Line Co.	16,796	—	16,796	9,837	3,763	28,709	—	259	551	—	810
77	Paloma Pipe Line Co.	15,750	—	15,750	2,319	990	5,780	7	N/A	N/A	N/A	N/A
78	Acorn Pipe Line Co.	15,421	—	15,421	4,312	1,700[B]	3,341	13	N/A	N/A	N/A	N/A
79	Kaw Pipe Line Co.	14,390	—	14,390	3,677	671	11,748	84	1,402	—	—	1,402
80	Gulf Central Pipeline Co.	—	14,170	14,170	19,008	5,124	120,687	1,239	—	—	1,901	1,901
81	Kiantone Pipeline Corp.	13,133	—	13,133	2,758	640	12,491	—	—	78	—	78
82	Western Oil Transportation Co., Inc.	13,078	—	13,078	3,578	18,630	14,088	350	—	400	—	400
83	Vickers Pipeline Co., Inc.	12,258	—	12,258	1,101	N/A	4,133	—	—	30	—	30
84	Okie Pipe Line Co.	7,997	4,198	12,195	4,627	1,747	13,847	—	500	—	384	884
85	Allegheny Pipeline Co.	—	11,340	11,340	5,289	1,624	24,532	334	—	—	602	602
86	Jet Lines, Inc.	—	11,285	11,285	3,914	1,645	11,456	32	—	—	111	111
87	Pioneer Pipe Line Co.	—	10,251	10,251	2,632	539	11,745	52	—	—	303	303
88	Tesoro Pipeline Co.[B]	10,000	—	10,000	3,200	1,000	7,000	—	169	188	—	357
89	Interstate Energy Co.	—	9,661	9,661	9,189	335	54,949	348	—	—	94	94
90	Union Alaska Pipeline Co.	8,831	—	8,831	53,799	20,680	122,715	(23,344)	—	818	—	818
91	Phillips Alaska Pipeline Corp.	8,637	—	8,637	53,897	21,192	123,868	(22,541)	—	818	—	818
92	Trans Ohio Pipeline Co.	—	8,559	8,559	2,099	727	13,834	2	—	—	133	133
93	Trans Mountain Oil Pipe Line Corp.	8,430	—	8,430	340	86	6,742	—	—	64	—	64
94	Amerada Hess Pipeline Corp.	8,318	—	8,318	54,812	17,715	146,552	1,567	—	818	—	818
95	Crown-Rancho Pipe Line Corp.	8,230	—	8,230	1,435	870	2,189	(9)	N/A	461	N/A	461
96	Arapahoe Pipe Line Co.	6,165	—	6,165	1,604	997	10,798	(148)	296	270	—	566
97	Mobil Eugene Island Pipeline Co.	5,632	—	5,632	2,669	1,347	13,115	4,984	N/A	N/A	N/A	N/A
98	POGO Offshore Pipeline Co.	5,462	—	5,462	2,349	N/A	7,946	N/A	N/A	N/A	N/A	N/A
99	Cheyenne Pipe Line Co.	176	5,090	5,266	1,782	799	5,919	(8)	5	34	220	259
100	Powder River Corp.	—	5,262	5,262	2,723	432	9,511	—	—	—	679	679

Footnotes: B. Estimated

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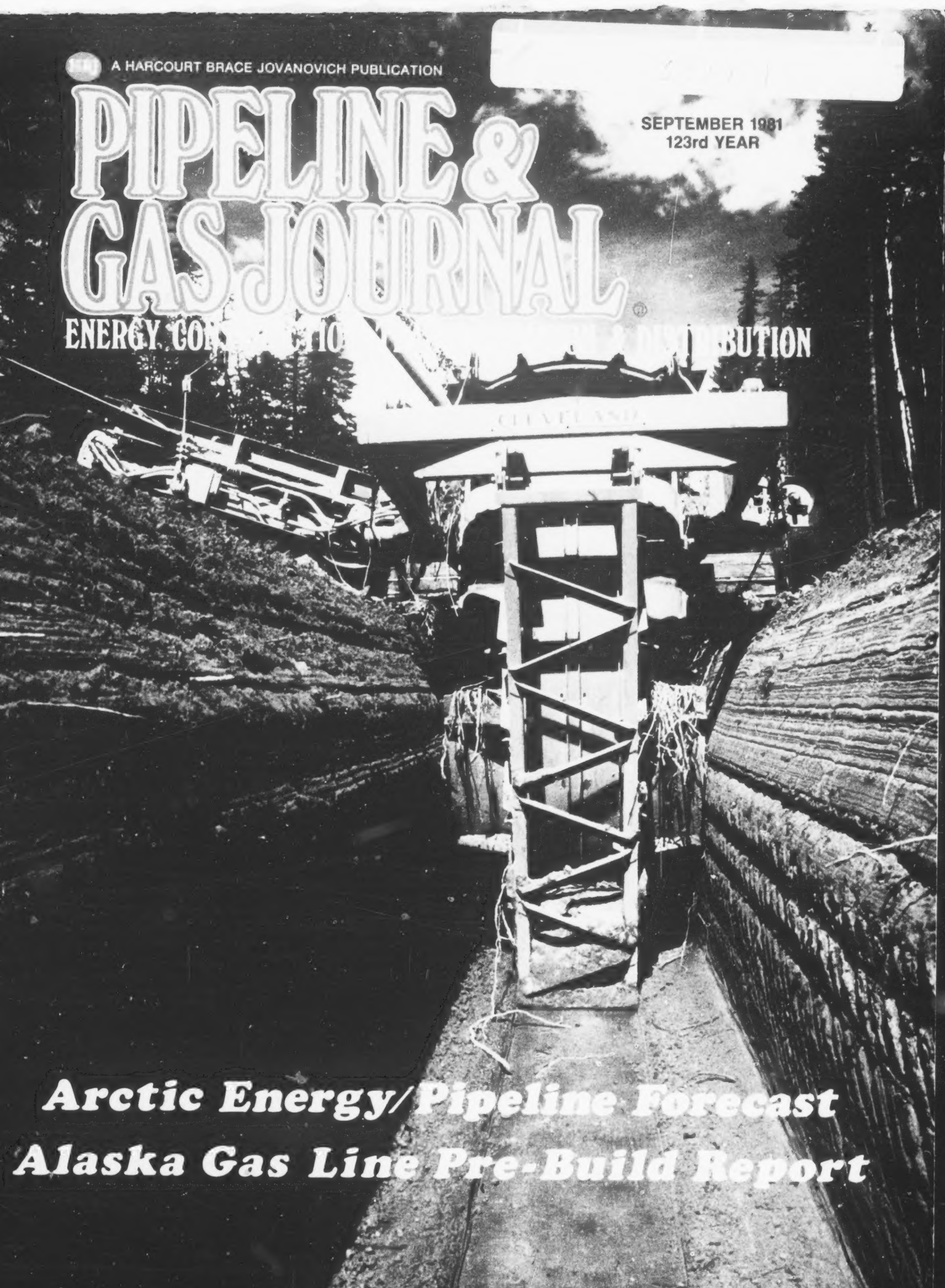

Arctic Energy/Pipeline Forecast

Alaska Gas Line Pre-Build Report

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COVER
Big trencher cuts deep ditch for 42-in. pipe on Section 1 loop of Pacific Gas Transmission system near Sandpoint, Idaho, part of "western leg" of the Alaska Highway Gas Pipeline Project.

–Photo courtesy Cleveland Trencher Co., Div. of Amhoist

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Alyeska Communications System Expanding 84
To meet needs along the oil line and in various communities, 20 earth stations are being added to Alyeska network.

Arctic Energy Pipelines Report

–photo courtesy Hobart Brothers Company

Prebuilding of Western and Eastern Legs of Alaska Highway Gas Pipeline Project will result in completion of more than one-third of total project mileage, permit early movement of gas to market from western Canadian sources on a temporary basis.

Financing Next Step In Building Alaska Gas Line

by Dean Hale, *Editor*

Alaskan natural gas is inching its way closer to the lower 48 states in a slow but methodical fashion. The Western Leg of the line's prebuild delivery system – 132 miles in Canada, 160.5 miles along the Pacific Gas Transmission line, and 351 miles looping Northwest Pipeline's Oregon and Idaho system – has been constructed and is ready for operation in October 1981.

Another big chunk of the overall 4800-mile system–this one involving 823 miles of 42-in. for the Northern Border Pipeline and 395 miles of 42-in. in Alberta and Saskatchewan for Foothills Pipeline Ltd. – is being constructed and will be completed for operation by Nov. 1, 1982.

When both are completed they will accommodate deliveries of more than 1 billion cu ft of gas per day to West Coast and Midwestern markets. Some 240 MMcf/day will go to Southern California and 800 MMcf/day will go to Northern Border participants. That 1.04 Bcf of natural gas is estimated to replace some 200,000 bbl per day of imported oil in the U.S. energy scene.

Building the Western and Eastern Legs prior to the main line from Prudhoe Bay provides many advantages, system sponsors point out, specifically in better utilization of materials, equipment, and labor while enjoying earlier depreciation of facilities that will result in lower rates to consumers. Building now also means avoiding higher costs later due to inflation.

The 1890 miles of pipelines involved is a substantial part of the overall system – over one-third – and evidences that the world's biggest energy transportation project can and will move forward.

Another big step lies just ahead for the Alaska Highway Gas Pipeline Project – arranging the financing so that the Federal Energy Regulatory Commission will issue a certificate of public convenience and necessity–and that in turn will permit actual construction on the Alaska and major cross-Canada sections to begin.

To expedite financing will also require some help from the U.S. Congress, which is being asked to grant certain waivers of previous legislation. Administration officials, Congressional staff, and industry are working hard on getting approval for the waiver proposals so that construction financing can be quickly arranged.

The basic waiver requests include:

- **Billing commencement.** The Alaska gas transportation tariff approved by FERC provides that billing from gas consumers cannot begin until the entire system is completed and commissioned as capable of delivering gas even though gas deliveries may not have begun. Canada's NEB-approved tariff provides billing of full cost of service when the Canadian segment is complete and commissioned. Canadian companies say that the billing commencement okayed by NEB is absolutely essential to finance the Canadian facilities. Waiver would permit such billing by both Canadian facilities and for Alaskan facilities when complete and commissioned. Without such a waiver, financing is not considered possible.
- **Producer equity.** Private financing requires some producer investment in debt and equity in the Alaska facilities. Producers would own equity interest of less than 50% initially and throughout life of project and would not be allowed access to the transportation system nor could they restrict its expansion.
- **Conditioning plant.** Plant should be integral part of the pipeline system but should not be subject to the incentive rate of return mechanism that is now required for most of the pipeline system.
- **Regulatory consistency.** Final, non-appealable orders issued by FERC covering all remaining regulatory actions necessary to begin construction must be effective when

Pipeline & Gas Journal

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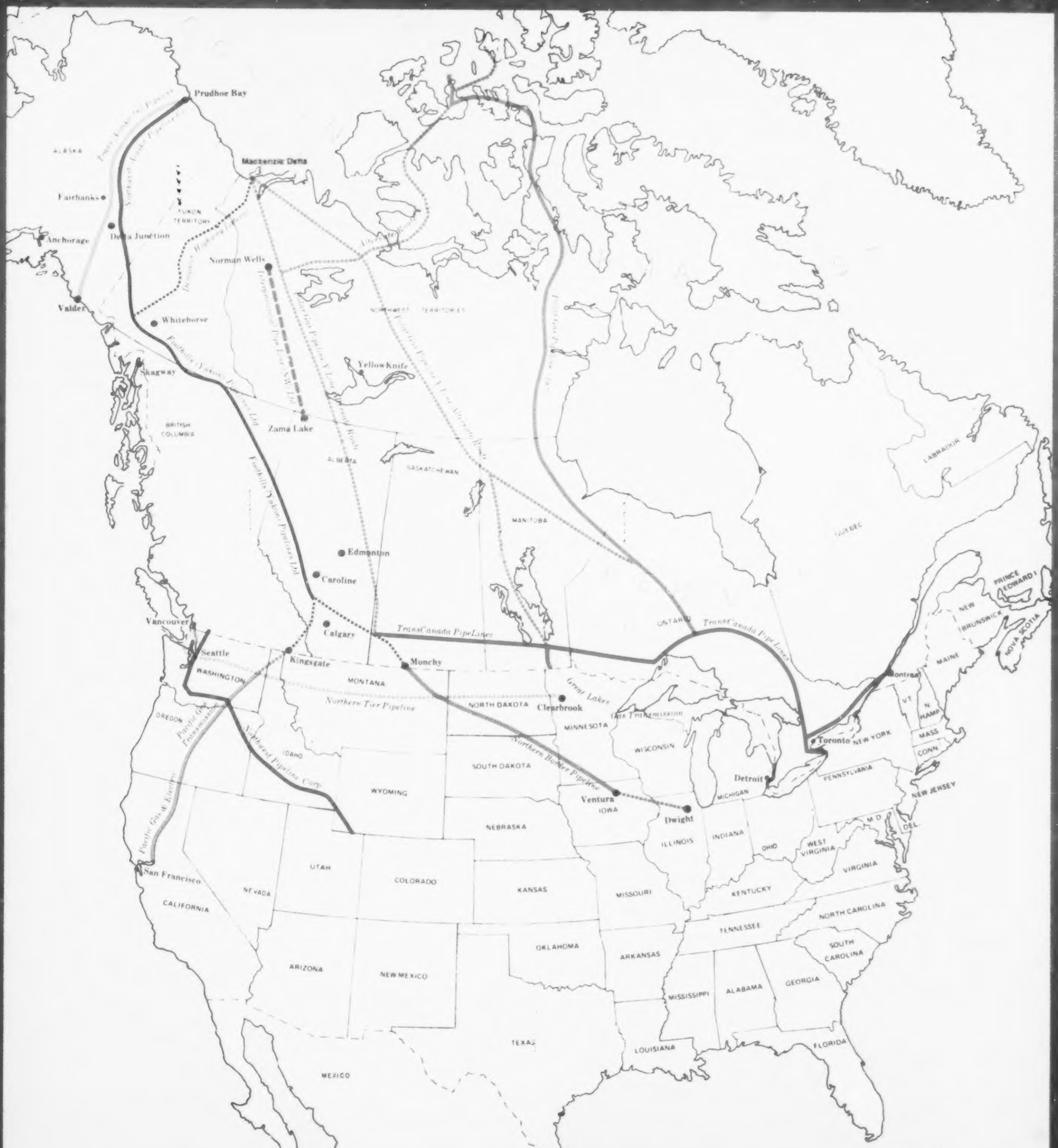
September 1981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ALASKA
Fairbanks
Anchorage
Delta Junction
Valdez
Mackenzie Delta
YUKON TERRITORY
Dempster Highway Lateral
Norman Wells
Whitehorse
Skagway
Foothills (Yukon) Pipelines Ltd
Interprovincial Pipe Line (NW) Ltd
Zama Lake
Yellowknife
Alternate Route
NORTHWEST TERRITORIES
BRITISH COLUMBIA
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TransCanada PipeLines
Northern Tier Pipeline
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Northern Border Pipeline
Ventura
Dwight
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Moving Arctic Energy To Market

Status of Projects and Proposals – September 1981

Type	Name	Size and Miles	Location	Status
Oil	Trans-Alaska Oil Pipeline	801 miles, 48-in.	Prudhoe Bay to Valdez	Completed and operating.
Oil	Northern Tier Pipeline Co.	1557 miles, 40 and 42-in.	Port Angeles, Wash. to Clearbrook, Minn.	Federal approval and all state approvals but Washington received; financing and permitting underway.
Oil	Interprovincial Pipe Line (NW) Ltd.	540 miles, 12-in.	Norman Wells, N.W.T., to Northern Alberta	Approved by NEB, but delayed until 1985.
Gas	ALASKA HIGHWAY GAS PIPELINE PROJECT			
	Northwest Alaskan Pipeline Co.	745 miles, 48-in.	Prudhoe Bay to Alaska-Canada (Yukon) border	Final application for construction certificate made to FERC; expect approval in 1982.
	Foothills Pipe Lines (South Yukon) Ltd.	232 miles, 48-in. 276 miles, 56-in.	Southern Yukon	Expect Canadian federal approval when Alaskan section is approved.
	Foothills Pipe Lines (North B.C.) Ltd.	444 miles, 56-in.	Nothern British Columbia	Expect Canadian federal approval when Alaskan section is approved.
	Foothills Pipe Lines (Alberta) Ltd.	394 miles, 56-in.	Alberta	Expect Canadian federal approval when Alaskan section is approved.
		187 miles, 36-in. 234 miles, 42-in.		Prebuild sections. Construction complete on 77 miles of 36-in. Construction underway on 234 miles of 42-in.
	Foothills Pipe Lines (South B.C.) Ltd.	105 miles, 36-in.	Southeastern B.C.	Approval given for prebuild; construction completed on 55 miles of 36-in.
	Foothills Pipe Lines (Saskatchewan) Ltd.	161 miles, 42-in.	Saskatchewan	Approval given for prebuild; construction underway.
	Northern Border Pipeline Co.	823 miles, 42-in.	Monchy, Sask. to Ventura, Iowa	Construction underway; completion by October 1982.
	Pacific Gas Transmission Co.	160.5 miles, 42-in. in four loops.	Idaho, Washington, Oregon	Construction completed; operational in October 1981.
	Pacific Gas Transmission Co. and Pacific Gas & Electric Co.	721 miles, 42-in.		Awaiting FERC approval.
	Northwest Pipeline Co.	100 miles, 30-in. 251 miles, 24-in.	Oregon, Idaho	Loop on existing system; construction completed; operational October 1981.
	Foothills Pipe Lines	740 miles, 34-in.	Near Whitehorse to Mackenzie Delta area	Proposed; estimated cost $2.5 billion (as of June, 1979).
Gas	POLAR GAS PROJECT	3100 miles, 30, 36, and 42-in.	High Arctic Islands and Mackenzie Delta to southern Canada	Project plans to file new application with National Energy Board for new "Y"-line.

accepted with no further action required and must not be altered during life of the project in any manner that would impair service of debt.

- **Regulatory reform to achieve expedition.** Structuring of procedures to assure that all required approvals are final and non-appealable by Feb. 1, 1982.
- **Rolled-in pricing.** Provides assurance that U.S. shippers and lenders who contract for purchase of Alaska gas and ted to roll-in or average Alaska gas costs with other gas acquisition costs.

Speedy Action Required

Inability to resolve problems related to regulatory actions, rates, rolled-in pricing, billing commencement, and other areas has prevented the arrangement of construction financing for the Alaska Highway Gas Pipeline Project, say the sponsors, and they are urging Congress and the Administration to take action.

Time slippage on the project has been significant. As reported in PIPELINE & GAS JOURNAL last September, the overall schedule then proposed was for a certificate to be granted by March 1, 1981, civil work to begin by Jan. 1, 1983, mainline construction work to begin by Feb. 1, 1984, and construction completed by Sept. 1, 1985, with gas deliveries scheduled for the 1985-86 winter season.

It is now one year later and the schedule proposed has, again, slipped one full year.

Even with prompt Congressional action, gas deliveries could not begin before late 1986.

Total cost of the project currently is set at $19.1 billion (in 1980 dollars). That includes $2.6 billion for Lower 48 construction (now almost complete), $5.2 billion for Canadian construction, and $11.3 billion for Alaskan construction.

High side estimates for final costs, taking into consideration inflation for the next five or six years, is that the pipeline will cost $21 billion, the conditioning plant will cost $6 billion, and a $3 billion cost overrun pool should be established – a total of $30 billion. Producers would participate in this for $9 billion (30%).

Even though financing arrangements haven't been completed, a great amount of work is underway on the pipeline, including engineering and design of the line itself and of the gas conditioning plant. (Both are featured in separate articles in this issue.)

Busy Field Program Schedule

Final year of intensive data gathering activities related to design, construction, and operation of the Alaska Highway Gas Pipeline Project has been a busy one, with 18 major field programs underway. Field programs scheduled include fisheries (water bodies crossed or potentially affected by pipeline construction); cultural resources (summer archeological field program); human-carnivore interaction; endangered species and raptors (peregrine falcon field moni-

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toring); revegetation field studies; timber survey (merchantable timber from Yukon River to Alaska-Yukon border);

Site assessment (includes analysis of material sites, spoil disposal sites, solid waste disposal sites, temporary facilities including access roads, miscellaneous sites); trench stability (including blasting techniques in frozen soils as well as ditch wall stability under varying seasonal construction and soil types); field survey along the route at compressor station sites, proposed access roads, temporary facilities, stream crossings, and miscellaneous areas; material sites (to identify material for workpad, ditch backfills, other construction needs); airports and temporary facilities; drilling of boreholes along entire route; fault study – Delta Junction North (extension of fault study made in 1980 from Canadian border to Delta Junction);

Frost heave test sites (seven frost heave test sites constructed for operation through 1981); hydrographic survey (gather hydrologic information for stream crossing designs); water resource survey (to find water sources for seven compressor stations, three new camps, and one Alyeska camp); soil uplift and differential frost heave (test sections constructed in Fairbanks frost heave test area); and long-term surface disturbances (related to thermal analysis of pipeline design).

Route surveying is the biggest program with some 150 people working in the field; firms involved include Fluor, Gulf Interstate/Michael Baker joint venture, and International Technology, Ltd. Second biggest activity is borehole drilling, with 1400 holes to be drilled in 1981 (2600 have been drilled in previous six years) by The Drilling Co. of Anchorage and Reading & Bates/Doyon joint venture. Other firms working on the program include Gulf Interstate/Michael Baker and Arctic Test Lab.

The other major field activity is the frost heave testing program. Contractors on this program include Professional Contractors, Inc., Anchorage; Reading & Bates/Doyon; Modern Construction/Tamak, Fairbanks; C.R. Lewis Co., Anchorage; Earthmovers, Fairbanks; H.C. Price Co., Fairbanks; and Doyon/Ghemm Co., Inc., Fairbanks.

Other Alaskan Gas Developments

Final contract covering engineering services on the 745-mile Alaskan segment was executed early in 1981 by Northwest Alaskan Pipeline Co. and the Southern California Div. of Fluor Engineers and Constructors, Inc. Contract permits Fluor to proceed with $300 million of additional engineering work and other services, including continuing field programs and the start of final design. Fluor has been doing engineering on the line since its selection as managing contractor in 1978.

A giant step forward in getting the gas pipeline built was taken when the Department of Interior granted rights-of-way for the pipeline across more than 400 miles of federal lands in Alaska. The grant requires that the gas line be separated by 200 ft or more from facilities of the trans-Alaska oil pipeline operated by Alyeska Pipeline Service Co., except under specific conditions approved by the Office of Federal Inspector. Several hundred other terms and conditions attached to the right-of-way grant establish environmental, technical, and construction standards for the line.

Northwest Alaskan Pipeline also has been granted air quality permits for seven compressor stations in Alaska. The move permits the pipeline company to obtain manfacturers' bids on gas turbines and compressor units to be installed at each location. The seven stations will be located 80 to 130 miles apart along the pipeline. Two stations will be north of the Brooks Range, three between Brooks and Delta Junction, and two stations between Delta Junction and the U.S.-Canadian border.

The Department of Energy has also recommended to FERC that the remaining Western Leg facilities be built with 42-in. pipe rather than 36-in. pipe. Economic advantages would outweigh the additional $102 million in capital costs for the 328 miles of the PGT segment.

Polar Gas Project

Design work is continuing on the Polar Gas Project, designed to tap natural gas reserves in the High Arctic Islands and, ultimately, deliver 3.3 billion cu ft of gas per day to southern Ontario. As presently visualized, Polar Gas would involve 3100 miles of 30, 36, and 42-in. pipeline and would require 12 construction spreads working for four years to complete. Another year would be required to complete all facilities.

Some 1689 miles of the line would be in permafrost; more than 2000 miles of gravel or insulated workpad would be needed. About 40 miles of line would need special supports. Over 20% of the line will require anchors or set-on weights or concrete weight coating.

Two major marine crossings would be required to get the line to Victoria Island and then on to Melville Island. The southern crossing, 19 miles with maximum depth of 400 ft, would cross Dolphin and Union Strait. The northern crossing, much more difficult, would be 76 miles long with a maximum depth of 1650 ft and would cross McClure Strait. This long crossing would utilize the ice hole bottom pull method, with a configuration of six strings of pipe, each 67,966 ft long. Each string would have 12 sections of 5663 ft each.

Arctic Pilot Project

Hearings are planned for late 1981 on the Arctic Pilot Project (consortium of Petro-Canada, Nova Corp., Dome Petroleum Ltd., and Melville Shipping Ltd.) that proposes to ship LNG from the Arctic to southern Canada on a year-around basis.

Project is designed to deliver 1.765 trillion cu ft of gas over 20 years to markets in the U.S. or Europe, by displacement. That's equivalent to 88.3 billion cu ft per year, or 240 million cu ft per day. Gas would come from Panarctic Oil Ltd.'s field at Drake Point on Melville Island, transported by pipeline, to Bridport Inlet on southern coast of the island. Nova would build the pipeline. Huge ice breaker LNG transports would carry the liquefied gas to an LNG terminal in southern Canada.

Other Developments

On the North Slope, development of Kuparuk Field west of Prudhoe Bay is underway by ARCO, which has drilled some 40 wells on its 12,800 acre tract. The wells, each producing 2000 bbl per day, will be brought on stream in April 1982 to provide 80,000 bbl per day to the trans-Alaska oil pipeline. ARCO is presently building a 26-mile, 16-in. insulated oil line to connect the field to Pump Station 1.

Sohio, which has leases west of ARCO's, (representing about 8 to 10%), plans to develop its area and have wells producing by 1983. The connecting pipeline, with a 200,000 bbl per day capacity, can accommodate the total field production for some time.

Moving Alaska oil to market once it arrives on the West Coast of the U.S. is still the subject of controversy and planning. Northern Tier Pipeline Co., which plans 1550 miles of 40 and 42-in. pipeline from near Seattle to Minnesota, expects to complete financing arrangements by November 1981 and to begin construction in early 1982.

A one-time competitor, Trans Mountain Oil Pipe Line Co. of Vancouver, which had received Canadian NEB approval for a 775-mile, 36-in. line from Washington to near Edmonton to transport Alaskan crude oil, has postponed plans for its line. The $650 million line would have had a capacity of 300,000 to 500,000 bbl per day. Trans Mountain pointed out that refineries in the area it would serve – and further down the transportation system – are operating at 50% of capacity and it could not justify building the line.

P&GJ

Downstream Operations Limit Earnings

by Greg Martin, *Editor, ENERGY NEWS/ENERGY WEEK*

Refining and marketing operations improved over first quarter, but not enough. That was the common theme of integrated companies' earnings reports in second quarter.

Greater income from exploration/production in first half of 1981 was offset by lower margins on downstream business. As a group, the 74 oil companies in our survey showed a 4.7% decline in net income from first half of 1980. Profit margin for the group fell from 6.4% to 5.4%.

Higher prices for U.S. crude oil after decontrol in January, and for natural gas under phased decontrol, lifted earnings of independent producers, though "windfall profits" tax eliminated much of the gain on crude production.

Domestic production made U.S. earnings better than foreign earnings for international operators. Also, strengthening of the U.S. dollar against other currencies resulted in lower margins in foreign countries when expressed in dollars.

Excluding currency translation gains of $588 million (compared to losses of $368 million in second quarter 1980), Exxon's worldwide earnings fell 13.3% from 1980 because of lower margins on refined products and a 15% decline in sales. U.S. refining/marketing in first half 1981, though better than operations abroad, lost $20 million, compared to $147 million profit in same 1980 period.

Shell Oil showed big gain in exploration/production earnings in first half, but downstream earnings fell and overall income remained flat. Standard California's U.S. oil/gas earnings were up 81% but overall net was

FIRST HALF GAS COMPANY FINANCIAL REPORTS

	Three months ending June 30**						Six months ending June 30**						Profit△ Margin	
	Revenues ($000)			Earnings* ($000)			Revenues ($000)			Earnings* ($000)				
Company	1981	1980	% Chg.	1981	1980	% Chg.	1981	1980	% Chg.	1981	1980	% Chg.	1981	1980
Alabama Tennessee N.G.	27,065	20,124	+ 34.5	1,313	1,311	+ 0.2	106,134[3]	86,877[3]	+ 22.2	5,583[3]	5,154[3]	+ 8.3	5.3	5.9
American Nat. Resources	590,044	459,770	+ 28.3	23,788	16,524	+ 44.0	1,479,146	1,244,981	+ 18.8	85,042	70,684	+ 20.3	5.7	5.7
Arkansas Louisiana Gas	302,421	242,061	+ 24.9	32,602	22,376	+ 45.7	1,088,217[3]	903,349[3]	+ 20.5	82,185[3]	78,320[3]	+ 4.9	7.6	8.7
Coastal Corp.	1,414,706	1,116,527	+ 26.7	(37,494)	28,590		3,186,108	2,562,891	+ 24.3	(24,155)	54,981			2.1
Columbia Gas	862,677	739,542	+ 16.7	31,423	30,629	+ 2.6	2,302,498	2,041,924	+ 12.8	114,817	113,107	+ 1.5	5.0	5.5
Commonwealth Nat. Res.	56,191	40,458	+ 38.9	1,267	1,041	+ 21.7	133,037	110,665	+ 20.2	4,242	4,165	+ 1.9	3.2	3.8
Consolidated N.G.	524,518	464,856	+ 12.8	22,171	11,067	+100.3	1,567,560	1,418,062	+ 10.5	93,389	81,070	+ 15.2	6.0	5.7
El Paso Companies†	1,007,000	898,000	+ 12.1	37,772	6,131	+516.1	2,008,000	1,737,000	+ 15.6	68,676	40,879	+ 68.0	3.4	2.4
ENSERCH Corp.	821,566	617,744	+ 33.0	46,197	31,169	+ 48.2	1,656,408	1,312,431	+ 26.2	102,120	73,801	+ 38.4	6.2	5.6
Houston N.G.[1]	732,963	603,418	+ 21.5	59,478	56,031	+ 6.2	1,452,440	1,190,050	+ 22.0	121,285	105,326	+ 15.2	8.4	8.9
Internorth	737,980	603,871	+ 22.2	39,305	42,722	- 8.0	1,880,595	1,542,267	+ 21.9	155,667	153,187	+ 1.6	8.3	9.9
Mountain Fuel Supply	113,743	95,863	+ 18.7	7,168	7,219	- 0.7	260,300	224,888	+ 15.7	21,743	22,169	- 1.9	8.4	9.9
National Fuel Gas	174,883	135,965	+ 28.6	841	(1,499)		755,137[4]	625,623[4]	+ 20.7	30,495[4]	21,502[4]	+ 41.8	4.0	3.4
Northwest Energy	287,178	283,770	+ 1.2	14,169	10,741	+ 31.9	715,878	715,298	+ 0.1	37,166	28,836	+ 28.9	5.2	4.0
ONEOK Inc.	261,049	205,506	+ 27.0	12,051	9,300	+ 29.6	594,926	485,712	+ 22.5	33,291	30,231	+ 10.1	5.6	6.2
Pacific Lighting	803,948	663,109	+ 21.2	33,596	22,855	+ 47.0	1,593,811	1,435,245	+ 11.0	74,223	45,555	+ 62.9	4.7	3.2
Panhandle Eastern	844,428	550,282	+ 53.5	78,961	37,405	+112.0	1,723,382	1,207,469	+ 42.7	156,759	97,828	+ 60.2	9.1	8.1
Peoples Energy	700,212	671,286	+ 4.3	24,610	25,700	- 4.2	1,934,698	1,747,148	+ 10.7	113,380	91,942	+ 23.3	5.9	5.3
Pioneer Corp.	308,022	234,788	+ 31.2	28,401	22,390	+ 26.8	596,177	445,271	+ 33.9	57,599	45,820	+ 25.7	9.7	10.3
Southern Nat. Res.	623,444	400,516	+ 55.7	37,996	30,748	+ 23.6	1,301,498	954,298	+ 36.4	85,344	67,798	+ 25.9	6.6	7.1
Southern Union Co.	239,173	218,914	+ 9.3	8,568	8,186	+ 4.7	557,465	475,877	+ 17.1	27,832	25,839	+ 7.7	5.0	5.4
Texas Eastern Corp.	1,017,967	1,057,379	- 3.7	59,915	55,569	+ 7.8	2,172,514	2,144,090	+ 1.3	122,523	116,827	+ 4.9	5.6	5.4
Texas Gas Trans.	590,366	511,124	+ 15.5	28,315	18,837	+ 50.3	1,273,530	1,096,457	+ 16.1	59,943	43,910	+ 36.5	4.7	4.0
Texas Oil & Gas[2]	296,062	216,432	+ 36.8	50,570	37,250	+ 35.8	1,149,402[4]	866,497[4]	+ 32.6	138,809[4]	101,292[4]	+ 37.0	12.1	11.7
TransCanada PipeLines							1,797,576	1,516,076	+ 18.6	64,314	47,322	+ 35.9	3.6	3.1
Transco Companies	931,973	601,327	+ 55.0	31,085	27,228	+ 14.2	1,797,163	1,187,562	+ 51.3	62,471	55,586	+ 12.4	3.5	4.7
United Energy Res.	1,277,800	929,401	+ 37.5	53,908	37,096	+ 45.3	2,541,876	1,964,183	+ 29.4	109,312	78,798	+ 38.7	4.3	4.0
TOTAL	15,547,379	12,582,033	+ 23.6	727,976	596,616	+ 22.0	37,625,676	31,242,191	+ 20.4	2,004,055	1,701,929	+ 17.8	5.3	5.4

**Excluding non-recurring items. *Earnings available to common stock. △Ratio = Earnings ÷ Revenues. [1]Ends April 30. [2]Ends May 31. [3]Twelve months. [4]Nine months. †1980 earnings reflect loss from discontinued LNG operations. ()Loss held down by lower margins on foreign refining/marketing.

Gulf Oil's worldwide losses from downstream business, excluding Gulf Canada Ltd., totaled $212 million in first half 1981, compared to $476 million profit in same 1980 period.

Despite much higher income from oil/gas and sulfur production, Pennzoil's net income continued to fall from 1980 levels because of lower product margins. Lower margins also caused decline for Marathon Oil.

Coastal Corp. posted net loss in second quarter as worldwide refining/marketing losses of $73.9 million more than offset higher profits on oil/gas production, gas pipelining and coal operations.

Dorchester Gas had big gains in production earnings, but unprofitable refining operations led to an overall decline. Same factor caused decline for Crystal Oil, which also cited higher interest rates – "almost twice what would be expected, given the improvement in inflation measures."

FIRST HALF OIL COMPANY FINANCIAL REPORTS

		Three months ending June 30**						Six months ending June 30**						Profit Margin†	
		Revenues ($000)			Earnings* ($000)			Revenues ($000)			Earnings* ($000)				
		1981	1980	Chg.	1981	1980	Chg.	1981	1980	Chg.	1981	1980	Chg.	1981	1980
1.	Adams R&E	53,435	57,394	- 7.4	(3,231)	(1,945)		119,174	119,705	- 0.4	(5,525)	(3,043)			
2.	Adobe Oil	43,356	40,170	+ 7.9	6,004	5,264	+ 14.1	82,661	79,391	+ 4.1	11,160	10,332	+ 8.0	13.5	13.0
3.	Amcole Energy	899	565	+ 59.1	25	(188)		2,712[4]	1,453[4]	+ 86.6	148[4]	(434)[4]		5.6	
4.	Alaska Interstate	80,330	61,512	+ 30.6	6,284	18,063	-187.4	171,608	118,247	+ 45.1	24,230	28,901	- 16.2	14.1	24.4
5.	American Petrofina	713,724	494,147	+ 44.4	15,251	25,123	- 39.3	1,300,198	1,017,521	+ 35.6	35,501	56,533	- 37.2	2.6	5.6
6.	American Quasar	14,403	11,753	+ 22.5	814	1,395	- 41.6	28,119	21,838	+ 28.8	1,601	3,637	- 56.0	5.7	16.6
7.	Ashland Oil	2,516,913	2,121,931	+ 18.6	3,796	40,768	- 90.7	4,883,005	4,162,090	+ 17.3	4,511	83,030	- 94.6	0.1	2.0
8.	Atlantic Richfield	6,968,034	5,667,450	+ 22.9	380,106	436,416	- 12.9	14,100,354	11,128,626	+ 26.7	726,590	863,433	- 15.8	5.2	7.8
9.	Beard Oil	9,216	4,948	+ 86.3	1,416	1,207	+ 17.3	16,267	10,657	+ 52.6	2,495	2,410	+ 3.5	15.3	22.6
10.	Brock Exploration	1,296	1,174	+ 10.4	(232)	55									
11.	Cities Service	2,208,500	1,814,300	+ 21.7	90,500	107,000	- 15.4	4,484,100	3,986,300	+ 12.5	148,200	277,100	-46.5	3.3	7.0
12.	Clark O&R	432,382	431,167	+ 0.3	13,008	11,246	+ 15.7	863,090	833,441	+ 3.6	8,539	25,346	- 66.3	1.0	3.0
13.	Consolidated O&G	12,813	8,317	+ 54.1	1,711	(384)		24,350	16,458	+ 48.0	3,693	(290)		15.2	
14.	Conoco Inc.	4,916,600	4,657,300	+ 5.6	158,700	249,600	- 36.4	10,312,800	8,987,300	+ 14.7	409,600	578,200	- 29.2	4.0	6.4
15.	Crown Central	380,785	331,891	+ 14.7	3,915	3,404	+ 15.0	758,613	635,445	+ 19.4	(6,313)	14,882			2.3
16.	Crystal Oil	83,635	60,491	+ 38.3	1,598	1,758	- 9.1	159,509	118,812	+ 34.3	25	4,645	- 99.5	--	3.9
17.	Diamond Shamrock	786,281	744,768	+ 5.6	(43,448)	56,346		1,623,830	1,459,521	+ 11.3	4,589	112,601	- 95.9	0.3	7.7
18.	Dorchester Gas[1]	166,418	135,493	+ 22.8	7,583	8,882	- 14.6	318,292	310,271	+ 2.6	14,214	16,465	- 13.7	4.5	5.3
19.	Dyco Petroleum	12,197	7,317	+ 66.7	3,594	1,919	+ 87.3	22,776	13,713	+ 66.1	6,550	3,530	+ 85.6	28.8	25.7
20.	Equity Oil	6,835	3,666	+ 86.4	1,736	948	+ 83.1	12,441	6,970	+ 78.5	2,887	1,789	+ 61.4	23.2	25.7
21.	Exxon	27,469,000	26,223,000	+ 4.8	1,825,000	1,030,000	+ 77.2	57,792,000	53,877,000	+ 7.3	3,425,000	2,955,000	+ 15.9	5.9	5.5
22.	Felmont	17,178	14,940	+ 14.8	3,297	4,201	- 21.5	36,225	26,888	+ 34.7	8,634	7,950	+ 8.6	23.8	29.6
23.	Forest	34,900	21,863	+ 59.6	946	538	+ 75.8	65,994	43,327	+ 52.3	3,228	2,661	+ 21.3	4.9	6.1
24.	Getty Oil	3,216,549	2,643,318	+ 21.7	204,775	242,887	- 15.7	6,511,170	4,912,017	+ 32.6	434,705	468,435	- 7.2	6.7	9.5
25.	Gulf Energy & Develop.	14,112	10,935	+ 29.1	1,726	1,884	- 8.4	28,181	19,801	+ 42.3	3,289	3,397	- 3.2	11.7	17.2
26.	Gulf Oil Corp.	7,200,000	6,794,000	+ 5.9	311,000	470,000	- 33.8	15,074,000	14,547,000	+ 3.6	614,000	859,000	- 28.5	4.1	5.9
27.	Helmerich & Payne	81,326	52,060	+ 56.2	20,297	12,054	+ 68.4	157,316	105,539	+ 49.1	39,001	23,984	+ 62.6	24.8	22.7
28.	Holly Corp.[2]	93,725	112,568	- 16.7	382	3,376	- 88.7	190,129	213,287	- 10.9	1,769	6,274	- 71.8	0.9	2.9
29.	Inexco Oil	61,694	35,977	+ 71.5	8,447	5,602	+ 50.8	114,592	67,697	+ 69.3	14,792	11,349	+ 30.3	12.9	16.8
30.	KRM Petroleum	1,382	1,194	+ 15.7	244	185	+ 31.9	2,734	2,402	+ 13.8	498	575	- 13.4	18.2	23.9
31.	Kerr-McGee Corp.	890,812	854,246	+ 4.3	51,445	49,577	+ 3.8	1,806,938	1,634,640	+ 10.5	94,782	96,719	- 2.0	5.2	5.9
32.	Lear Petroleum	38,903	19,624	+ 98.2	356	1,714	- 79.2	105,072[4]	65,547[4]	+ 60.3	5,745[4]	5,340[4]	+ 7.6	5.5	8.1
33.	Louisiana L&E	298,141	258,436	+ 15.4	41,655	42,832	- 2.7	620,943	523,390	+ 18.6	92,217	94,425	- 2.3	14.9	18.0
34.	Mapco Inc.	505,373	450,799	+ 12.1	29,009	40,165	- 27.8	1,085,394	829,610	+ 30.8	54,444	71,461	- 23.8	5.0	8.6
35.	Marathon Oil	2,133,752	2,039,893	+ 4.6	86,602	108,325	- 20.1	4,557,850	4,305,261	+ 5.9	156,377	247,396	- 36.8	3.4	5.7
36.	Marion Corp.	110,576	137,253	- 19.4	(1,550)	4,956		228,462	237,105	- 3.6	3,668	8,953	- 59.0	1.6	3.8
37.	May Petroleum	10,494	5,757	+ 82.3	1,922	1,224	+ 57.0	19,751	11,083	+ 78.2	4,562	2,577	+ 77.0	23.1	23.3
38.	Maynard Oil	11,015	7,633	+ 44.3	1,613	1,245	+ 29.6	20,997	14,399	+ 45.8	3,929	2,276	+ 72.6	18.7	15.8
39.	McMoRan Oil & Gas	45,498	22,009	+106.7	10,775	6,792	+ 58.6	102,975	40,061	+ 157.0	24,629	12,062	+104.2	23.9	30.1
40.	Mesa Petroleum	100,911	94,949	+ 6.3	26,074	24,652	+ 5.8	204,535	201,880	+ 1.3	55,915	44,565	+ 25.5	27.3	22.1
41.	Mobil Corp.	16,600,000	15,400,000	+ 7.8	700,000	688,000	+ 1.7	33,700,000	30,700,000	+ 9.8	1,340,000	1,534,000	- 12.6	4.0	5.0
42.	Moran Energy	22,749	15,131	+ 50.3	4,541	2,630	+ 72.7	42,713	28,801	+ 48.3	8,908	4,830	+ 84.8	20.9	16.8
43.	Murphy Oil	660,021	454,838	+ 45.1	44,995	35,633	+ 26.3	1,326,827	1,024,083	+ 29.6	83,425	64,023	+ 30.3	6.3	6.3
44.	Natomas	370,276	336,676	+ 10.0	57,557	57,399	+ 0.3	735,706	626,796	+ 17.4	115,794	105,414	+ 9.8	15.7	16.8
45.	Noble Affiliates	93,402	67,265	+ 38.8	18,341	12,090	+ 51.7	180,905	134,849	+ 34.2	36,391	25,549	+ 42.4	20.1	18.9
46.	Nugget Oil Corp.[3]	464,315	388,146	+ 19.6	119,094	126,102	- 5.5	1,554,894[5]	1,265,861[5]	+ 22.8	249,902[5]	523,879[5]	- 52.3	16.1	41.4
47.	Pacific Resources	233,347	179,983	+ 29.6	2,793	4,871	- 42.7	464,729	386,943	+ 20.1	1,413	13,901	- 89.8	0.3	3.6
48.	Patrick Petroleum	31,033	13,347	+132.5	3,344	1,049	+218.8	78,728	42,341	+ 85.9	6,234	1,035	+502.3	7.9	2.4
49.	Peninsula Resources	5,522	3,512	+ 57.2	278	260	+ 6.9	10,671	6,852	+ 55.7	533	405	+ 31.6	5.0	6.0
50.	Pennzoil Co.	672,115	630,996	+ 6.5	57,981	76,542	- 24.2	1,360,103	1,243,901	+ 9.3	117,104	159,043	- 26.4	8.6	12.8
51.	Petroleum Development	3,199	4,876	- 34.4	258	350	- 26.3	6,464	8,364	- 22.7	614	840	- 26.9	9.5	10.0
52.	Phillips Petroleum	4,072,955	3,230,179	+ 26.1	229,767	214,849	+ 6.9	8,301,424	6,614,341	+ 25.5	500,551	499,263	+ 0.3	6.0	7.6
53.	Quaker State	219,919	200,891	+ 9.5	7,367	7,496	- 1.7	438,076	395,751	+ 10.7	11,003	14,375	- 23.5	2.5	3.6
54.	Sabine Corp.	42,992	30,253	+ 42.1	7,422	5,504	+ 34.8	85,435	58,328	+ 46.4	16,035	11,853	+ 35.3	18.8	20.3
55.	Seneca Oil	3,101	895	+247.0	927	16	+5611.0	5,812	2,730	+113.0	1,260	339	+271.0	22.0	12.0
56.	Shell Oil	5,554,000	4,895,000	+ 13.5	410,000	407,000	+ 1.4	10,967,000	9,693,000	+ 13.1	771,000	780,000	- 1.2	7.0	8.0
57.	Southland Royalty	104,647	67,060	+ 35.9	10,423	2,536	+ 75.7	200,327	129,730	+ 35.2	20,410	7,966	+ 61.0	10.2	6.1
58.	Southwestern Energy	11,026	8,931	+ 23.5	2,335	1,819	+ 28.4	32,033	26,929	+ 19.0	7,853	6,164	+ 27.4	24.5	22.9
59.	Standard California	10,979,000	10,649,000	+ 3.1	616,000	535,000	+ 15.1	22,967,000	21,096,000	+ 8.9	1,282,000	1,162,000	+ 10.3	5.6	5.5
60.	Standard Ohio	2,907,900	2,840,600	+ 2.4	478,700	451,300	+ 6.1	6,027,200	5,499,300	+ 10.0	999,100	902,000	+ 10.8	16.6	16.4
61.	Statex Petroleum[3]	2,356	1,596	+ 46.3	333	317	+ 4.9	4,840	2,839	+ 70.5	922	503	+ 83.1	19.0	17.7
62.	Sun Co.	3,900,000	3,000,000	+ 30.0	298,000	247,000	+ 20.7	7,900,000	6,100,000	+ 29.5	418,000	498,000	- 16.1	5.3	8.2
63.	Superior Oil	504,181	350,618	+ 43.8	99,295	68,635	+ 44.7	997,087	680,905	+ 46.4	207,255	137,001	+ 51.3	20.8	20.1
64.	Supron Energy	19,612	16,191	+ 21.1	5,160	4,625	+ 11.6	37,473	31,247	+ 19.9	10,121	9,235	+ 8.5	27.0	29.8
65.	Tenneco	3,776,000	3,201,000	+ 18.0	203,000	186,000	+ 9.1	7,585,000	6,517,000	+ 16.4	397,000	364,000	+ 9.1	5.2	5.6
66.	Texaco	14,799,000	12,537,300	+ 18.0	555,700	502,900	+ 10.5	30,258,400	25,786,200	+ 17.3	1,213,700	1,103,500	+ 10.0	4.0	4.3
67.	Tosco	866,915	598,264	+ 44.9	12,072	23,983	- 49.7	1,629,344	1,132,426	+ 43.9	(26,616)	46,612			4.1
68.	Transcontinental Energy	23,977	18,777	+ 27.7	2,981	174	+1613.2	46,421	36,767	+ 26.3	6,100	168	+3531.0	13.1	0.5
69.	Tribune Oil	657	465	+ 41.3	208	141	+ 47.5	1,220	937	+ 30.2	372	332	+ 12.0	30.5	35.4
70.	Union California	2,685,800	2,648,000	+ 1.4	207,900	194,800	+ 6.7	5,280,100	4,930,300	+ 7.1	362,400	347,700	+ 4.2	6.9	7.1
71.	Universal Resources	15,442	9,626	+ 60.4	3,513	1,638	+114.4	29,587	18,913	+ 56.4	6,321	2,846	+122.1	21.4	15.0
72.	Wilshire Oil of Texas	4,330	3,173	+ 36.5	1,402	672	+108.6	8,119	6,003	+ 35.2	2,205	1,425	+ 54.7	27.2	23.7
73.	Wiser Oil	16,528	14,949	+ 10.5	4,625	3,315	+ 39.5	33,440	30,061	+ 11.2	9,884	8,351	+ 18.3	29.6	27.8
74.	Woods Petroleum	16,055	12,880	+ 24.7	4,074	3,311	+ 23.0	32,432	24,848	+ 30.5	8,741	6,377	+ 37.1	27.0	25.7
TOTAL		131,425,765	118,286,626	+ 11.1	7,443,531	6,887,043	+ 8.1	270,418,667	238,989,039	+ 13.2	14,619,814	15,346,395	- 4.7	5.4	6.4

**Excluding non-recurring items. *Earnings available to common stock. †Earnings* divided by Revenues. [1]Ends May 31. [2]Ends January 31. [3]Ends April 30. [4]Nine months. [5]Twelve months. ()Loss.

Second Quarter Report

Clark Oil, Tosco and Pacific Resources all turned first quarter losses into second quarter profit as crude oil prices dropped about $3/bbl during second quarter and companies were able to recover more raw material and operating costs. Tosco said its ability to refine lower quality, less expensive crude strengthened refining margins.

Net income for Ashland Oil and Quaker State continued to drop from 1980 levels. Ashland said it is reducing higher priced inventories as crude oil prices are moderating.

Wooed and (at this writing) apparently won by DuPont Co. largely because of its coal reserves, Conoco attributed its decline in second quarter income mainly to a strike by United Mine Workers, which resulted in loss of $51.5 million on coal operations, compared to $37 million profit in second quarter 1980.

Exxon paid $1.16 billion of "windfall profits" tax alone in first half 1981. Other WPT totals: Standard Ohio, $813.3 million; Atlantic Richfield, $833 million; Shell Oil, $773 million; Standard California, $678 million; Texaco, $639.2 million; Gulf, $634 million; Mobil, $524 million.

Non-utility operations continued to lead gains in net income for large gas companies. Earnings for the survey group rose respectably in both second quarter and first half 1981.

Higher profits from oil/gas production led to first half improvement for Consolidated Natural Gas. Gas sales to industry have improved.

Exploration/production was largest income producer for ENSERCH in second quarter and oilfield services again showed biggest gain. Gas sales and income for Lone Star utility division rose because of greater sales to electric utilities and industry.

United Energy Resources' higher income levels reflected more gas sales at higher prices and stronger contract drilling operations.

Contract drilling has shown greatest percentage increase in profitability among ONEOK's subsidiaries.

Non-utility segments were source of earnings gains for Southern Union, more than offsetting lower earnings from gas utility operations.

All-time high results for Texas Oil & Gas were due to higher gas gathering volumes, higher levels of production and prices for company-owned gas, and good contract drilling results.

All operations for Texas Gas Transmission – pipelining, oil/gas production, trucking, inland waterways – were higher than in same 1980 period.

Higher utility earnings were chief factor in Pacific Lighting's first half improvement.

First half earnings for InterNorth were flat and second quarter earnings fell from same 1980 quarter. Business recession hurt gas sales, petrochemical and liquid fuels operations.

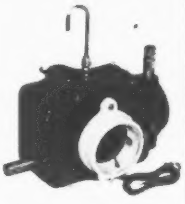
Lower than normal industrial activity also caused lower gas sales for Alabama-Tennessee.

Mountain Fuel Supply's first half earnings dropped from 1980 mainly because of less profitable utility operations. Oil exploration/production showed substantial gains.

CONTROL TIPS

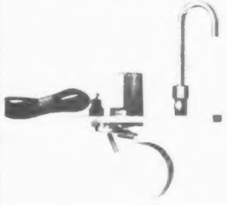
AUTOMATICALLY MAINTAIN SAFE CRANKCASE LEVELS.

LR-900



LR-900EX

LR-557



Automatically adds the proper amount of oil to your crankcase without shutting down the engine. Model LR-900 is recommended for use on any vented or non-vented crankcase. A metering device allows only the proper amount of oil to flow into the crankcase and features a safety switch to shut down the engine if the supply tank is depleted. The LR-557 is designed to keep proper levels in McCord and similar lubricators.
PAT. NO. 4038507

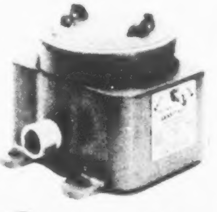
HIGH PRESSURE LIQUID LEVEL FLOAT SWITCH.

L-1200/L-1200N FLOAT SWITCH

The L-1200 Float Switch is designed for level control on compressor scrubbers, pressure vessels, heater treaters, boilers or any process requiring liquid level monitoring. A rugged and dependable Snap Action, Float Actuated Level Switch, the L-1200 is designed especially to offer compact liquid level monitoring for medium to high pressure applications requiring "explosion proof" construction. All moving parts which come in contact with fluid are made of stainless steel to resist corrosion. Pneumatic Models combine same features with snap acting pilot valve.
pat. no. 3970099

VIBRATION SWITCH DETECTS SEVERE EQUIPMENT OSCILLATION.

VS-2-EX VIBRATION SWITCH



This vibration and shock switch is sensitive to abnormal oscillation in three planes of motion and easily adjustable to detect any degree of abnormal vibration from heavy shocks — which occur if couplings parted on a pumping unit, to minute vibrations found on high frequency equipment.

The magnetic latching feature assures virtually no wear on the internal tripping mechanism. Whenever acceleration of the equipment exceeds the holding force of the magnet, the latching member is released and D.P.D.T. contacts, rated 5 amps at 480 V AC, are transferred. Pneumatic Model (VS-2-N) vents 20-80 psi supply for equipment shutdown.
PAT. NO. 3641290/3967493

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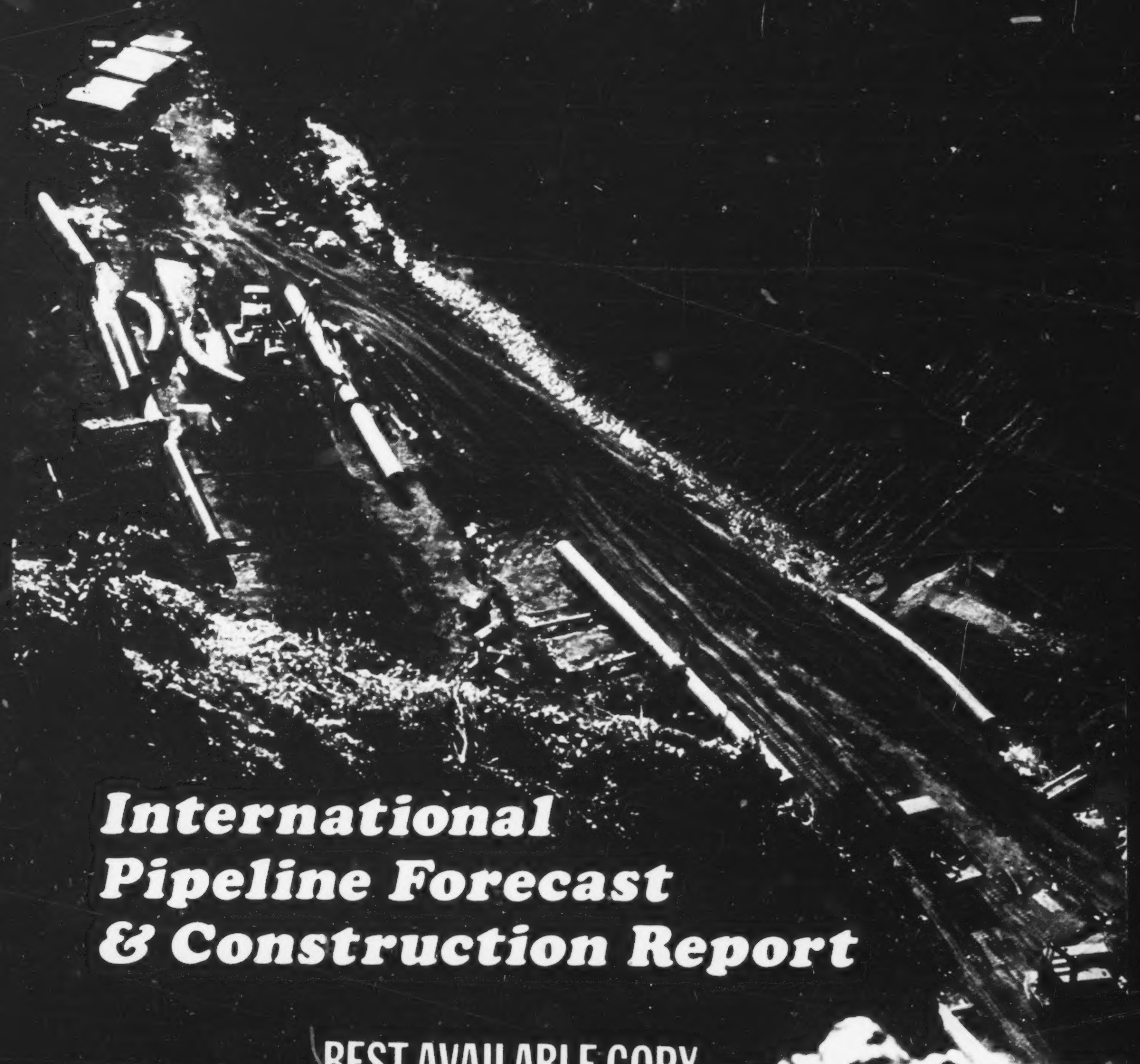

International Pipeline Forecast & Construction Report

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International Pipeline & Gas Utility Design, Construction & Operation

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COVER
Construction on the 48-in. gas pipeline on mainland Italy, for Trans-Mediterranean Gas Pipeline Co., is well underway with over 215 km complete and construction spreads moving north over rugged terrain to complete the big line in time for 1983 operation.

-photo courtesy Saipem S.p.A.

Worldwide Construction Reaches 113,000 Miles, $138 Billion 29

Superprojects abound as planning for movement of energy supplies around the globe intensifies; latest P&GJ survey indicates over 78,000 miles planned or underway in Free world. Total cost of all planned and underway lines estimated at $138 billion.

Danish Gas System Construction Progressing On Schedule 38

First cross-country gas transmission line for the Danish Oil and Natural Gas system is nearing completion between Froslev and Egtved.

Trans-Mediterranean Gas Line Advancing On Rome 46

Huge 1550-mile inter-continental gas pipeline system linking Algerian fields to Italian industrial centers nearing completion; lines in Algeria and Tunisia to complete in November, Sicilian section complete, work underway on mainland.

Twin Australian Lines Have Many Problems 55

Dual products and natural gas lines being installed between Sydney and Newcastle have suffered delays because of labor problems, terrain, and mechanical problems; lines are scheduled to be completed by end of 1981.

Mobile Repair Train Developed 58

O&K of Germany has developed a traveling "repair train" of specialized vehicles to provide service to heavy equipment on projects in remote areas.

Pipeline Anchoring Saves Money 62

Major gas pipeline project finds auger anchors give big costs savings over set-on concrete weights; new tools insure anchors provide proper "hold down."

Construction Claims 71

Part 1 of new series provides introduction to management of construction claims – essential to maintaining the financial health of contractors and capital projects alike; discussed are key project tools and the project "post mortem" approach.

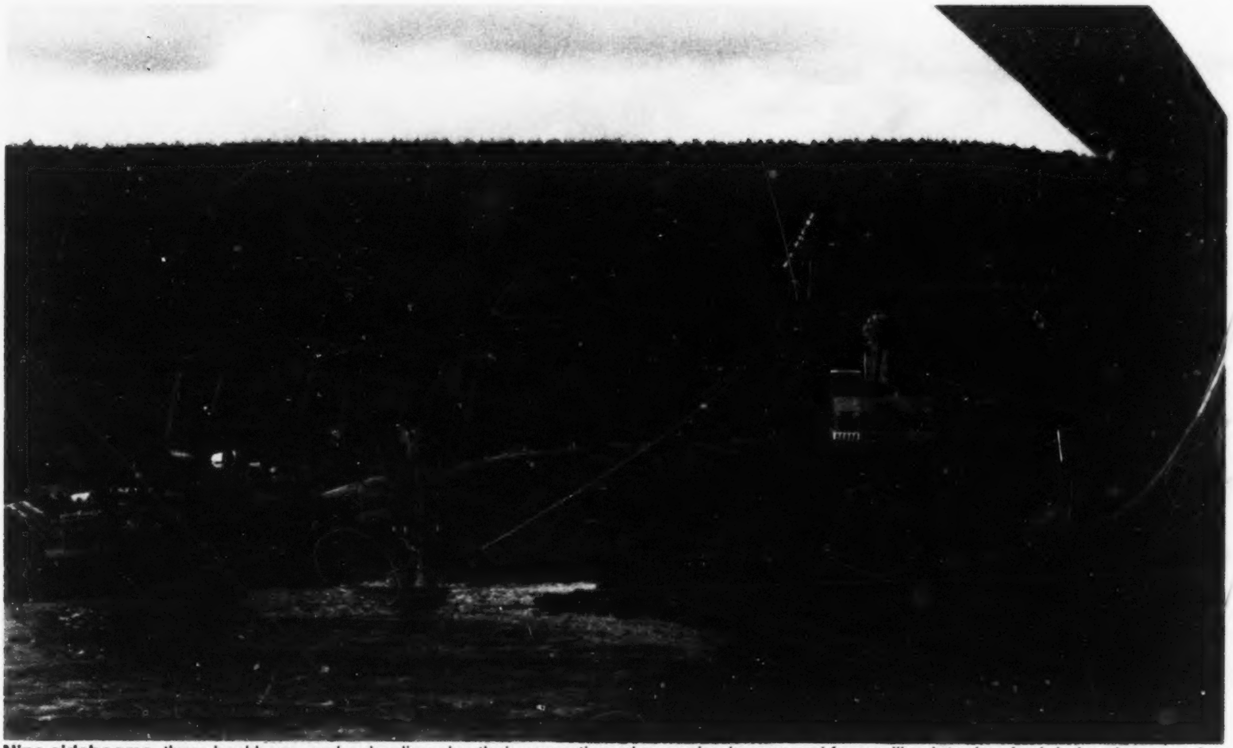
Testing and Calibrating Turbine Meters . . 78

Part 3 discusses field tests and how they are used to prove turbine meters; discussed are equipment used for field proving and suggested methods.

What's New In Valves and Valve Actuators 85

Showcase of the latest innovations in all types of valves and valve actuators used in oil and gas pipeline and gas distribution utility applications.

Construction Equipment Specifications . . 102



Nine sidebooms, three backhoes, and a dragline play their respective roles as pipe is prepared for cradling into river bed during river crossing installation operation on British Gas' 42-in. Fourth Feeder line in Scotland by Nacap crews.

Worldwide Projects Now Total Over 113,000 Miles, $138 Billion

by **Dean Hale,** *Editor*

International pipeline construction activity in 1982 will bring a new peak in expenditures, with an estimated $8.924 billion to be spent in 1982 for the construction of nearly 13,100 miles of natural gas, crude oil, petroleum products, gas liquids, and slurry pipelines in all global areas outside the United States. PIPELINE & GAS JOURNAL's survey of world pipeline activity reveals a total figure of 113,364 miles of lines planned or underway – at a cost of $138 billion – around the globe. That includes 35,720 miles in the U.S.S.R., the Eastern Bloc countries, and the Peoples Republic of China. Excluded is pipeline activity in Iran and Afghanistan.

For 1981, the PIPELINE & GAS JOURNAL worldwide survey indicates that 5127 miles of gas transmission, field, and gathering lines will be completed; 4660 miles of crude oil trunk lines and gathering lines; 2635 miles of petroleum products and natural gas liquids and LPG lines, and 1128 miles of offshore oil and gas pipelines and gathering lines.

That 13,550 mile total for 1981 construction reflects a commendable record of project completions around the world on both major and minor pipeline undertakings. That includes completion of the Algerian, Tunisian, and Sicilian sections of the Trans-Mediterranean Gas Pipeline; British Gas Corp.'s 42-in. fourth feeder line from St. Fergus; the initial pipeline work on the Danish Oil and Natural Gas system in Denmark; a considerable amount of oil and gas pipelines in Saudi Arabia and Abu Dhabi; the Gulf of Thailand 266-mile, 34-in. offshore gas line and the 105-mile, 28-in. land line.

Even with the completion of many major projects in the past few years, an exciting future lies ahead for the international pipeline business. Of the total projects listed in the P&GJ survey, 62.3% of the mileage is for natural gas lines, 21.4% is for crude oil pipelines, 13.6% is for products lines, and 2.7% is for slurry pipelines. Of pipelines currently under construction, 67% are natural gas, 26% are oil, and 7% are petroleum products lines.

INTERNATIONAL PIPELINE CONSTRUCTION

(As of September 1981)

	Miles		
Type of Line	**Total**	**Underway**	**Planned**
Natural gas	70,517	8,359	62,158
Crude oil	24,303	3,418	20,885
Petroleum Products	15,415	916	14,499
Slurry	3,129	—	3,129
TOTALS	**113,364**	**12,693**	**100,671**

INTERNATIONAL PIPELINE CONSTRUCTION – BY COUNTRIES

(Underway, Planned, and Proposed – September 1981)

	Total Miles, Gas Pipelines		Total Miles, Crude Oil Pipelines		Total Miles, Products Pipelines		Total Miles, Slurry Pipelines		Total Miles, All Pipelines	
Country	**Total**	**Underway**	**Total**	**Underway**	**Total**	**Underway**	**Total**	**Underway**	**Total**	**Underway**
Abu Dhabi	250	125	—	—	—	—	—	—	250	125
Algeria	2903	553	393	393	386	62	—	—	3692	1008
Argentina	3893	1258	300	—	12	—	88	—	4293	1258
Australia	2681	—	477	403	359	123	189	—	3706	526
Austria	—	—	—	—	—	—	—	—	—	—
Bangladesh	260	—	—	—	—	—	—	—	260	—
Belgium	226	—	—	—	—	—	—	—	226	—
Bolivia	1607	166	—	—	536	—	—	—	2143	166
Brazil	1207	264	907	264	360	—	9	—	2483	528
Bulgaria	—	—	—	—	—	—	—	—	—	—
Cameroons	125	—	2	—	—	—	—	—	127	—
Canada	10,408	844	1838	186	531	186	500	—	13277	1216
Chad	—	—	—	—	—	—	—	—	—	—
Chile	605	—	10	—	—	—	46	—	661	—
China	2000	—	1500	—	—	—	—	—	3500	—
Columbia	601	—	974	20	345	40	—	—	1920	60
Congo	—	—	14	—	—	—	—	—	14	—
Costa Rica	—	—	—	—	35	—	—	—	35	—
Czechoslovakia	535	535	—	—	—	—	—	—	535	535
Denmark	8060	59	—	—	—	—	—	—	8060	59
Dubai	—	—	17	—	—	—	—	—	17	—
Ecuador	478	162	6	—	55	—	—	—	539	162
Egypt	320	168	735	660	—	—	—	—	1055	828
France	2849	1519	350	—	169	—	—	—	3368	1519
Greece	70	—	50	—	—	—	—	—	120	—
Guatemala	—	—	237	—	—	—	—	—	237	—
Honduras	—	—	160	—	—	—	—	—	160	—
Hungary	—	—	188	—	112	—	—	—	300	—
India	534	—	18	—	660	330	620	—	1832	330
Indonesia	—	—	105	—	2	2	—	—	107	2
Iran*										
Iraq	350	350	1322	—	1011	—	—	—	2683	350
Ireland	158	—	—	—	—	—	—	—	159	690
Italy	869	598	86	86	6	6	—	—	961	—
Ivory Coast	—	—	—	—	—	—	—	—	—	—
Japan	1080	—	—	—	—	—	—	—	1080	—
Kenya	—	—	—	—	248	—	—	—	248	—
Korea	—	—	450	—	—	—	—	—	450	—
Kuwait	44	—	435	400	23	—	—	—	502	400
Libya	431	373	601	120	—	—	—	—	1032	493
Malaysia	80	—	—	—	—	—	—	—	80	—
Mexico	1057	60	228	—	1363	—	—	—	2648	60
Netherlands	130	—	123	—	100	—	—	—	353	—
New Zealand	685	—	—	—	105	105	—	—	790	105
Nigeria	3110	—	344	80	—	—	—	—	3454	80
Norway	—	—	—	—	—	—	—	—	—	—
North Sea	1184	—	158	—	—	—	—	—	1342	—
North Yemen	—	—	—	—	227	—	—	—	227	—
Oman	140	—	461	251	—	—	—	—	601	251
Pakistan	515	32	1065	525	—	—	—	—	1580	557
Panama	—	—	75	—	—	—	—	—	75	—
Peru	—	—	644	—	—	—	—	—	644	—
Poland	—	—	—	—	—	—	342	—	342	—
Portugal	—	—	—	—	69	—	—	—	69	—
Saudi Arabia	250	—	448	—	1506	—	—	—	2204	—
South Africa	225	—	—	—	—	—	—	—	225	—
Spain	305	—	30	—	68	—	—	—	403	—
Sudan	—	—	894	—	—	—	—	—	894	—
Syria	—	—	30	30	—	—	—	—	30	30
Sweden	185	—	—	—	—	—	—	—	185	—
Switzerland	71	71	—	—	—	—	—	—	71	71
Tanzania	—	—	—	—	678	—	—	—	678	—
Thailand	278	—	267	—	458	—	—	—	1003	—
Tunisia	508	179	—	—	—	—	—	—	508	179
Turkey	50	—	780	—	250	—	—	—	1080	—
Taiwan	44	—	135	—	166	—	—	—	345	—
United Kingdom	965	110	—	—	283	103	—	—	1248	213
USSR	18,022	1422	7180	—	4506	—	1335	—	31403	1422
Venezuela	27	—	185	—	—	—	—	—	212	—
W. Germany	221	—	81	—	201	—	—	—	503	—
Yugoslavia	—	—	—	—	—	—	—	—	—	—
Zaire	—	—	—	—	205	—	—	—	205	—
Zambia	—	—	—	—	380	—	—	—	380	—

**Iran data not included*

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INTERNATIONAL PIPELINE CONSTRUCTION – BY AREAS

(Underway, Planned, and Proposed – September 1981)

Area	Total Miles, Gas Pipelines		Total Miles, Crude Oil Pipelines		Total Miles, Products Pipelines		Total Miles, Slurry Pipelines		Total Miles, All Pipelines	
	Total	Underway	Total	Underway	Total	Underway	Total	Underway	Total	Underway
Europe	15294	2357	878	86	896	109	—	—	17068	2552
Africa	7622	1273	2983	1253	1897	62	—	—	12502	2588
Middle East	1034	475	3493	681	2767	—	—	—	7294	1156
Asia, Japan, Pacific	2761	32	2040	525	1536	332	620	—	6957	889
Australia & New Zealand	3366	—	477	403	464	228	189	—	4496	631
Canada	10408	844	1838	186	531	186	500	—	13277	1216
Mexico & Central America	1057	60	700	—	1398	—	—	—	3155	60
South America	8418	1850	3036	284	1308	95	143	—	12895	2229
Subtotal	**49960**	**6891**	**15435**	**3418**	**10797**	**1012**	**1452**	—	**77644**	**11321**
U.S.S.R.	18022	422	7180	—	4506	—	1335	—	31043	1422
Eastern Bloc	535	535	188	—	112	—	342	—	1177	535
China	2000	—	1500	—	—	—	—	—	3500	—
Subtotal	**20557**	**1957**	**8868**	—	**4618**	—	**1677**	—	**35720**	**957**
GRAND TOTAL	**70517**	**8848**	**24303**	**3418**	**15415**	**1012**	**3129**	—	**113364**	**13278**

In the Free World, Europe leads the list with a total mileage of 17,068 and with 2552 miles under construction. Canada is in number two spot, with 13,277 miles total and 1216 miles underway. South America again ranks third with a total of 12,895 miles total and 2229 miles actually under construction, followed closely by Africa, with 12,502 miles total and 2588 miles underway. Pipeline activity in the Middle East has diminished from recent highs, and now totals 7294 miles, with 1156 miles under construction. The Asia-Japan-Pacific area totals 6957 miles, with 889 miles underway, followed by Australia and New Zealand, with 4496 miles total and 631 miles underway, and Mexico and Central America, with 3155 miles total and 60 miles under construction.

Russia, which recently announced its latest five-year plan, has a total of 31,043 miles on the books and 1422 miles underway; mainland China's pipeline activity, 3500 miles planned, remains a mystery.

Super projects remain a major attraction in the world's future pipeline plans. Included in this category are the 960-mile Dampier-to-Perth gas pipeline in Western Australia; Norway's Statline 518-mile North Sea pipeline system; Nigeria's proposed 1560-mile gas line to the Mediterranean via Algeria, and Canada's proposed 3000-mile Polar Gas project.

Europe

Natural gas now supplies some 15% of the primary energy in Western Europe and, according to Dr. Burckhard Bergman of Ruhrgas in West Germany, 85% of the gas comes from domestic production. Dr. Bergman expects gas to keep and enlarge its share of the European energy market provided that prices remain competitive with other energy forms. That can only mean the need for gas pipelines will increase.

Major exporters of gas to Western Europe are U.S.S.R. and Algeria. Soviets are the leader at present, and Algeria will have a strong second position when gas begins flowing through the Trans-Mediterranean Gas Pipe Line. Western Europe now receives 52% of all gas exported in the world and is expected to take even more in the future.

Pipeline construction, presently at a moderate rate in Europe because of the high cost of money to finance projects, is experiencing slippage on many projects, both big and small. No downturn of activity is contemplated, but no major upswing is seen, either, P&GJ's survey indicates.

In the U. K., British Gas Corp. has completed its 280-mile, 42-in. fourth feeder line running southward from St. Fergus and current activity is confined to relatively short extensions and reinforcement lines.

The British North Sea Gas Gathering Network may not be built. The British government won't give support to the $4.9 billion project, involving 440 miles of 20 to 36-in. undersea lines to collect gas from 20 U. K. fields. Government said financial support was needed from the private sector and hasn't been given. A major reason, say oil company spokesmen, is the unwillingness of British Gas to commit itself to an across-the-board price for natural gas from the North Sea.

North Sea work abounds, however. The 57-mile Magnus field gas line and the 45-mile West Sole Field to Easington Gas Terminal line have both been installed. Work is underway on seven 6-in. flow lines at Magnus.

In Italy, work is progressing on the 649-mile mainland 48 and 42-in. gas pipeline to deliver Algerian gas to the industrial regions of both southern and northern Italy, as well as Rome. In the Mezzogiorno (Southland) region, a new gas utility will build pipelines to supply 364 communities at a cost of $180 million (see special report this issue).

Norway's gas pipeline system including 518 miles of 26, 30, and 36-in. is expected to get under construction in 18 months; the system must be completed by 1986. Main line from Statfjord to the Karstoe terminal will cross the deep (1075 to 1300 ft) Norwegian Trench. The line out from Karstoe to Ekofisk will cross it again.

Most activity in the Netherlands is offshore, with 135 miles of gas line and 50 miles of oil line planned. Another 125 miles of dual-phase oil/gas line is also planned by NAM/Union Oil/Petroland.

Denmark's planned national gas network is getting underway. First construction of 60 miles of 24-in. from Froslev to Estvig is nearing completion (see article this issue) and pipe for the 136-mile, 30-in. offshore line to connect Tyra Field to Esbjerg on the coast is now being coated. Another 40 miles of offshore 10 to 14-in. gathering lines are planned. The 1200 miles of transmission lines and 7500 miles of distribution laterals are being engineered for construction in 1983 and later.

West Germany's planned projects include a 90-mile oil line

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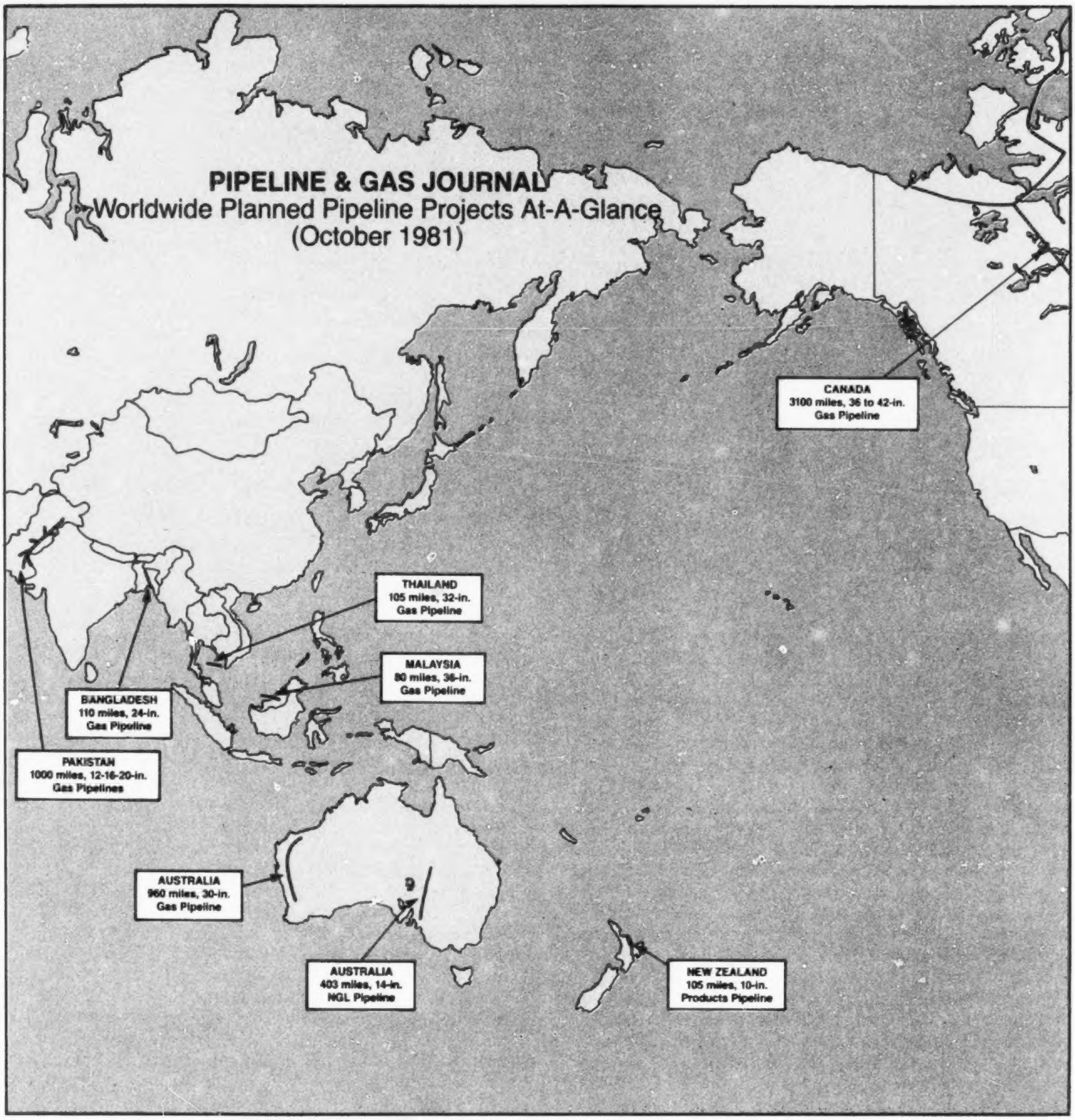

PIPELINE & GAS JOURNAL
Worldwide Planned Pipeline Projects At-A-Glance
(October 1981)

CANADA
3100 miles, 36 to 42-in.
Gas Pipeline
THAILAND
105 miles, 32-in.
Gas Pipeline
MALAYSIA
80 miles, 36-in.
Gas Pipeline
BANGLADESH
110 miles, 24-in.
Gas Pipeline
PAKISTAN
1000 miles, 12-16-20-in.
Gas Pipelines
AUSTRALIA
960 miles, 30-in.
Gas Pipeline
AUSTRALIA
403 miles, 14-in.
NGL Pipeline
NEW ZEALAND
105 miles, 10-in.
Products Pipeline

from Wilhelmshaven to Hamburg and 186-mile, 16-in. products line from Wilhelmshaven to the Ruhr Valley. Spain's Enagas is expanding its system with a 26-in. line from Burgos to Madrid, plus laterals to Guadalajara and Toledo and a line from Burgos to south of Vitoria. Enagas plans some 1500 miles of new lines by 1985.

Gaz de France is installing some 345 miles of gas transmission lines in 1981 and will install 406 miles in 1982. Sweden plans 188 miles of 24 and 36-in. gas line from Malmo to Halstead. A 70-mile offshore gas line from Otranto, Italy to Greece's Isle of Corfu is being studied by Snamprogetti.

Middle East and Africa

Two major pipeline proposals are in the news in this area of the world – one is the revived SEGAMO project involving some 200 miles of large diameter pipe between Algeria and Spain to carry gas – Bechtel reportedly has contract to study present-day feasibility; the other is a 1560-mile, 30 or 36-in. gas pipeline from Nigeria to Algeria's Mediterranean coast, with the gas to be exported to Western Europe. Nigeria reportedly is abandoning its Bonny LNG plant plans because of continuing cost escalation for the facility.

In Tunisia, state-owned gas and electric agency STEG plans 180 miles of 10 and 20-in. laterals and 250 miles of 8-in. gas distribution lines.

Algerian pipeline construction activity has softened with the deferral of numerous projects "to a later time." Algeria's Sonatrach and its LNG customers are having difficulty agreeing on new prices and LNG deliveries (and consequently revenues) have slowed or terminated. Similarly, Algeria has had difficulty selling its oil at premium prices. The 393-mile, 30-in. oil line from In Amenas to Haoud El Hamra in southern Algeria is being completed, as are other major projects that have been underway for some time. That includes the Trans-Mediterranean Gas Pipe Line from Hassi R'Mel to the Algerian-Tunisia border and the Tunisian sec-

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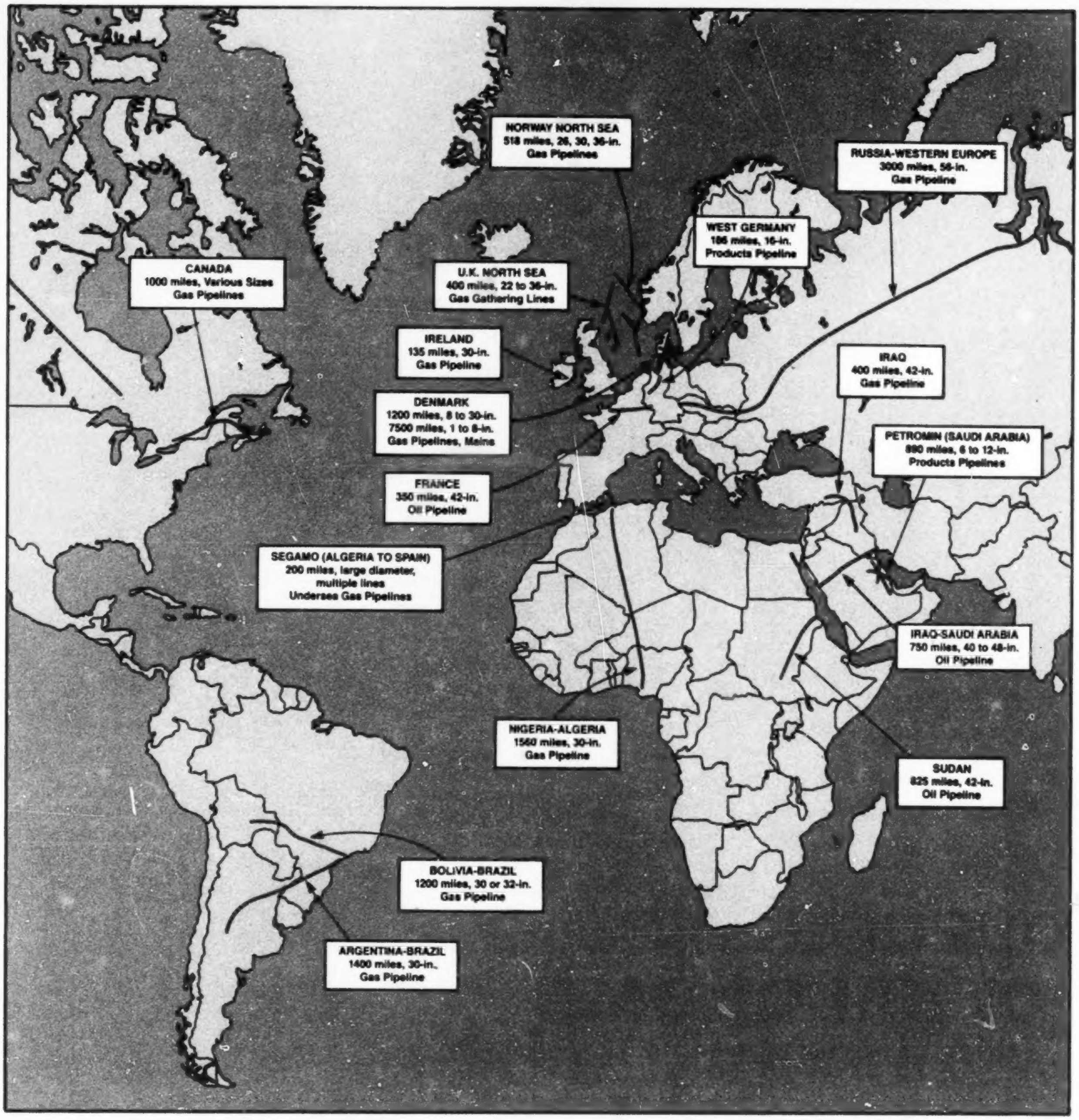
NORWAY NORTH SEA
518 miles, 26, 30, 36-in.
Gas Pipelines
RUSSIA-WESTERN EUROPE
3000 miles, 56-in.
Gas Pipeline
WEST GERMANY
186 miles, 16-in.
Products Pipeline
CANADA
1000 miles, Various Sizes
Gas Pipelines
U.K. NORTH SEA
400 miles, 22 to 36-in.
Gas Gathering Lines
IRELAND
135 miles, 30-in.
Gas Pipeline
IRAQ
400 miles, 42-in.
Gas Pipeline
DENMARK
1200 miles, 8 to 30-in.
7500 miles, 1 to 8-in.
Gas Pipelines, Mains
PETROMIN (SAUDI ARABIA)
890 miles, 6 to 12-in.
Products Pipelines
FRANCE
350 miles, 42-in.
Oil Pipeline
SEGAMO (ALGERIA TO SPAIN)
200 miles, large diameter,
multiple lines
Undersea Gas Pipelines
IRAQ-SAUDI ARABIA
750 miles, 40 to 48-in.
Oil Pipeline
NIGERIA-ALGERIA
1560 miles, 30-in.
Gas Pipeline
SUDAN
825 miles, 42-in.
Oil Pipeline
BOLIVIA-BRAZIL
1200 miles, 30 or 32-in.
Gas Pipeline
ARGENTINA-BRAZIL
1400 miles, 30-in.
Gas Pipeline

tion from there to Cap Bon. Both are to be completed in November.

Libya's activity includes 363 miles of 4 to 42-in by NKK-Marubeni-Zakhem, 120 miles of 16 and 20-in. by Montubi, and 280 miles of 18-in. by Entrepose. In Zaire, a 205-mile 20-in. products line is being studied by OTP. Sudan's government and Standard Oil of California are reported studying an 825-mile, 42-in. line from Abu Gabra to Port Sudan.

Southeast Asia and Pacific

Petrobangla, national oil company of Bangladesh, will build a 110-mile, 24-in. gas line costing $140 million; project, being designed by PLT Engineering, will also include 50 miles of 10, 16, and 20-in. lines. Thailand has planned a 105-mile, 32-in. line from Texas Pacific's "B" Platform to Union Oil's Block 12 platform, connecting with the newly completed line to Bangkok. Malaysia's principal project is the 80-mile, 36-in. gas line connecting the Sarawak LNG facility in Bintulu to the Luconia Field. In Pakistan, Sui Northern Gas is planning over 1000 miles of 12, 16, and 20-in. lines.

Australia has three major projects to attract pipeliners – the 84-mile, 40-in. offshore line linking the North Rankin field of the North West Shelf to Dampier; the 960-mile, 26 to 32-in. gas line from Dampier to Perth; and the 403-mile, 14-in. gas liquids line from Moomba area to Stony Point in South Australia. Steel has been ordered for the latter line, to be built by Santos Ltd. In New Zealand, design is underway on the 105-mile, 10-in. products line to cost $55 million that New Zealand Refining Co. is building from Marsden Point refinery to Wiri, near Auckland.

South America, Central America, Mexico

Biggest projects currently underway in South America are the 1084-mile Central West Gas project for Gas del Estado in Argentina, being built by Nacap and its associates, and Brazil's 340-mile Campos Basin offshore oil and gas system, now

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Two kibitzing camels survey the desert pipeline scene in Tunisia along the right-of-way of the Trans-Mediterranean 48-in. gas pipeline.

being installed, along with 309 miles of land lines.

A big major project now in design stage is the 1350-mile, 30 or 36-in. gas line from Bolivia's Santa Cruz province to the Sao Paulo industrial region of Brazil. Some 400 miles would be built in Bolivia, the other 950 miles in Brazil. Snamprogetti has a $2.7 million design contract for the line.

Argentina and Brazil also have plans for a joint gas line – a 1430-mile system to move gas from Argentina's San Geronimo area to the Sao Paulo area.

Bolivia has awarded a contract to OTP for design and construction management of 493 miles of 6 and 12-in. products lines from Santa Cruz to La Paz. In Ecuador, work is to get underway in late 1981 on 55 miles of 8 and 20-in. products line; a 163-mile, 12 and 14-in. gas line is currently underway.

In Venezuela, plans are being formulated to install some 1000 miles of 8 to 16-in. insulated hot oil lines in both eastern and western areas of Venezuela.

Design is underway on the 78-mile, 36-in. crude oil pipeline across Panama that will serve to link VLCC and ULCC tankers on the Pacific side to smaller vessels on the Atlantic side (that serve the Gulf of Mexico ports).

Pipeline activity in Mexico, until recently moving at a torrid pace, reportedly has slowed and many projects have been deferred because world demand for oil has declined and Mexico's oil revenues have, as a result, also declined. Pemex reportedly has 2600-plus miles of natural gas and products lines planned, with sizes ranging from 6 to 48-in.

Soviet Union

U.S.S.R.'s energy requirements continue to grow and the most recent (1981-1985) Five Year Plan reflects the need for pipelines to transport oil and gas energy. The Plan calls for

Eye-ball stretching scene from Algeria, showing pipe strung out along ditch on the 393-mile, 30-in line from In Amenas to Haoud El Hamra in southern Algeria, illustrates graphically the loneliness and emptiness of desert pipelining.

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Only a few tumbleweeds mar the the desolate, barren landscape as crews perform coating and lowering-in of 48-in. pipe on Algerian section of the Trans-Mediterranean Gas Pipe Line.

20,000 miles of gas pipelines, of which 10,375 miles will be 56-in. diameter, plus 7187 miles of crude oil pipelines and 4060 miles of petroleum products lines. The figures do not include the 3000-mile, 56-in. Yamal gas pipeline planned from western Siberian fields to Western Europe.

Progress on the Yamal line proposal has been stymied by financing problems. A recent agreement by German and Dutch banks on financing the project has given it new momentum. Soviet planners have agreed to purchase 400 tractors and air compressors from Japan, and are negotiating with U. K. suppliers for 150 gas turbine powered compressors and compressor station equipment. Pipe for the line would be supplied by West German, Dutch, Belgium, and Italian steel firms.

The Yamal project is expected to materialize because Western Europe will need the gas energy, and the long-awaited Soviet-Iran-European gas exchange deal of several years ago is not expected to be revived for a long time–if ever.

Canada

Pipeline activity in Canada will be intense if a number of major projects can be unleashed. If and when the U. S. finally approves the Alaska section of the Alaskan Highway Gas Pipeline Project, the section of line (48 and 56-in.) across the Yukon and Alberta will be a major undertaking. Meanwhile, work is planned for 1982 and later on the Trans-Quebec & Maritimes project (over 1000 miles of pipelines), the Polar Gas project of 3000 miles to bring High Arctic Islands' gas southward, and expansion of the TransCanada PipeLines system through major looping programs.

P&GJ

Big pipelaying barge *Semac I*, veteran of North Sea pipelaying adventures, was utilized to lay 11-mile crossing of the River Forth by British Gas Corp.